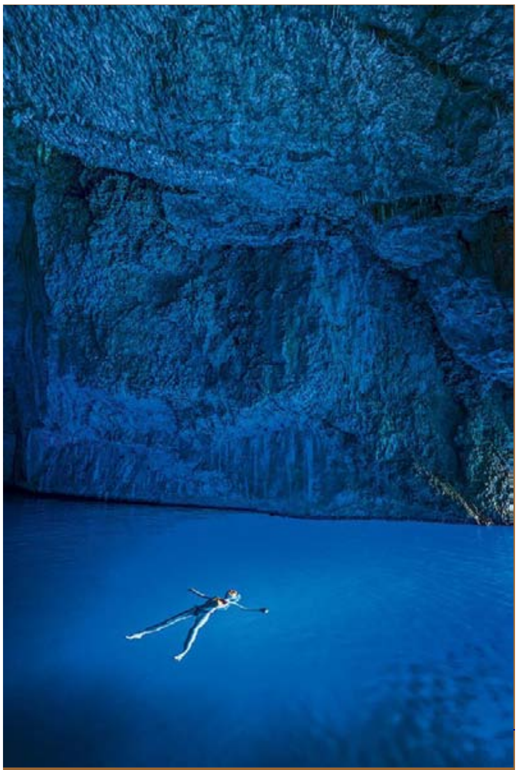

Γαλάζια Σπηλιά στη Μεγίστη (Καστελλόριζο)

ΕΛΛΗΝΙΚΗ ΕΠΙΣΤΗΜΟΝΙΚΗ ΕΤΑΙΡΕΙΑ ΕΔΑΦΟΜΗΧΑΝΙΚΗΣ & ΓΕΩΤΕΧΝΙΚΗΣ ΜΗΧΑΝΙΚΗΣ

Τα Νέα της Ε Ε Ε Ε Γ Μ

115

Αρ. 115 – ΙΟΥΝΙΟΣ 2018

SIMSG ISSMGE

ISRM

40 χρόνια από τον μεγάλο σεισμό της Θεσσαλονίκης

Η πόλη της Θεσσαλονίκης έχει ανάγκη από έναν οργανωμένο σχεδιασμό όλων των εμπλεκόμενων φορέων, υπό την εποπτεία της πολιτείας, που θα οδηγούν σε προσεισμικές βελτιώσεις σε καίρια σημεία του πολεοδομικού συγκροτήματος.

Και παράλληλα σε πρωτοβουλίες πολιτικής προστασίας, καθώς στο ενδεχόμενο ενός ίδιου μεγέθους σεισμού, ή μεγαλύτερου από αυτόν του 1978, οι επιπτώσεις και οι ζημίες θα είναι πολύ μεγαλύτερες, εξαιτίας της αλλαγής που υπέστη ο πολεοδομικός ιστός (κτιριακά, πληθυσμιακά, συγκοινωνιακά, στην ανάπτυξη νέων δικτύων κ.α.), τόσο σε έκταση, όσο και σε γήρανση.

(συνέχεια στην σελίδα 3)

Π Ε Ρ Ι Ε Χ Ο Μ Ε Ν Α

(συνέχεια από την πρώτη σελίδα)

Με αφορμή τον σεισμό του 1978

Την επισήμανση έκαναν επιστήμονες και μηχανικοί από το ΑΠΘ, το ΙΤΣΑΚ και το ΤΕΕ, σε μία επετειακή εκδήλωση για την συμπλήρωση 40 χρόνων (20-6-1978) από τον μεγάλο σεισμό της Θεσσαλονίκης, και η οποία φιλοξενήθηκε στο κτίριο του ΤΕΕ, στο πλαίσιο του 16ου Πανευρωπαϊκού Συνεδρίου Σεισμικής Μηχανικής που φιλοξενείται για πρώτη φορά στην Θεσσαλονίκη, με τη συμμετοχή πάνω από 1.500 συνέδρους (διοργανώνεται από το Ελληνικό Τμήμα Αντισεισμικής Μηχανικής – ΕΤΑΜ – της Ευρωπαϊκής Ένωσης Σεισμικής Μηχανικής, σε συνεργασία με το τμήμα Πολιτικών Μηχανικών του ΑΠΘ).

Σεισμολόγοι και μηχανικοί παρουσίασαν θέματα σχετικά με τον σεισμό του 1978 και την πρόοδο που έχει επέλθει από τότε σε ότι αφορά την ενίσχυση της αντισεισμικής προστασίας της πόλης, των υποδομών και της κοινωνίας, αλλά και σε επιστημονικό και ερευνητικό επίπεδο.

Ο καθηγητής Γεωμηχανικής του ΑΠΘ και πρόεδρος της Οργανωτικής Επιτροπής του Συνεδρίου, Κυριαζής Πιτιλάκης, τόνισε ότι πρέπει να περιμένουμε και να σχεδιάσουμε για έναν σεισμό που θα είναι μεγαλύτερος από αυτόν του 1978, και πρόσθεσε ότι το ζήτημα της πολιτικής προστασίας του πολεοδομικού συγκροτήματος της Θεσσαλονίκης ανήκει στην πολιτεία, η οποία είναι ήδη ενήμερη για τις μελέτες που έχουν γίνει και αφορούν για το είδος και το μέγεθος των ζημιών, τα προβλήματα που θα προκύψουν στην υδροδότηση, στις συγκοινωνίες, στο λιμάνι, αλλά και σε ανθρώπινες ζωές.

«Σε ότι αφορά τις υποδομές και τον δομικό ιστό της πόλης έχουν γίνει διάφορες μελέτες, οι οποίες έχουν φτάσει σε μία σειρά από αποτελέσματα, που δίνονται σε επίπεδο χαρτών για το πού θα γίνουν ζημιές, πόσες θα είναι – πόσα θα είναι τα κίτρινα σε ποσοστό, πόσα τα κόκκινα – ανά περιοχές, που θα έχουμε προβλήματα στην ύδρευση, που θα σπάσουν αγωγοί, ποιες γέφυρες θα έχουν προβλήματα μικρά ή μεγάλα, τι θα γίνει στο λιμάνι κοκ. Αυτά έχουν κατατεθεί, οπωσδήποτε υπάρχουν κάποιες αβεβαιότητες γιατί η κάθε μελέτη γίνεται με κάποιες υποθέσεις. Ο μελλοντικός σεισμός της Θεσσαλονίκης θα είναι μεγαλύτερος από το 1978, ή τουλάχιστον πρέπει να περιμένουμε και να σχεδιάσουμε για έναν σεισμό που θα είναι μεγαλύτερος. Δεν ήταν τόσο μεγάλος ο σεισμός εκείνος από άποψη καθαρά σεισμολογικών χαρακτηριστικών. Επομένως με τις μελέτες που υπάρχουν και στηρίζονται ακριβώς σε μία πιο καλή γνώση για το τι περιμένουμε, θα έχουμε ζημιές. Εφόσον είναι γνωστές οι ζημιές περίπου, με όποιο βαθμό αβεβαιότητας, η πολιτεία αυτό που πρέπει να κάνει είναι να πάρει τις μελέτες αυτές και να δει πως μπορεί να βελτιώσει προσεισμικά τόσο τις υποδομές όσο και κάποια κρίσιμα κτίρια, όπως σχολεία» είπε χαρακτηριστικά.

Στην παρουσίασή του, ανέφερε ότι με βάση ένα πιθανό σενάριο ενός μεγαλύτερου σεισμού (λαμβάνοντας υπόψη ότι ο στατιστικός αριθμός της μέσης περιόδου επαναφοράς μίας σεισμικής καταστροφής είναι τα 475 χρόνια) **η σεισμική διακινδύνευση του κτιριακού ιστού – όπως είναι σήμερα – υπολογίζεται και κατανέμεται στο 66% σε κίτρινα, στο 4% σε κόκκινα, και στο 30% σε πράσινα.** Ταυτόχρονα, θα υπάρξουν προβλήματα σε υποσταθμούς της ΔΕΗ, αστοχίες σε αγωγούς και δεξαμενές στο δίκτυο ύδρευσης, μερική ή πλήρης αστοχία σε κάποιες υποδομές του λιμανιού, προβλήματα προσβασιμότητας στα νοσοκομεία, ενώ το κόστος των ζημιών εκτιμάται ότι θα φτάνει τα 20 δισεκατομμύρια.

Ο κ.Πιτιλάκης, δήλωσε, ότι το ρήγμα του Ανθεμούντα (κοντά στην Περαία) θα πρέπει να μας φοβίζει περισσότερο από αυτό του 1978 (ρήγμα Βόλβης), αφού βρίσκεται πιο κοντά στην Θεσσαλονίκη, ενώ εκτίμησε ότι το ενδεχόμενο μεγαλύτερου σεισμού μπορεί να προκαλέσει καθιζήσεις έως και 30 εκατοστά στο λιμάνι και στην περιοχή του Καλοχωρίου.

Ο καθηγητής Γεωφυσικής του ΑΠΘ, Κώστας Παπαζάχος, τόνισε ότι γνωρίζουμε την σεισμικότητα στην περιοχή, τι κινδύνους δημιουργεί, τι επιπτώσεις θα έχει στην πόλη, τι σεισμικές κινήσεις πρέπει γίνουν και πως πρέπει να χτίσουμε την πόλη, ωστόσο, **υστερούμε σημαντικά στην προεπένδυση για τη μείωση των επιπτώσεων ενός σεισμού.**

«Το μεγαλύτερο πρόβλημα είναι ότι ο υφιστάμενος ιστός της πόλης, κυρίως στο κέντρο, γερνάει συνεχώς. Αν το '78 λοιπόν ήταν ο ιστός 30 ετών, για την επόμενη 20ετία – 30ετία, που πρέπει να σχεδιάσουμε, θα είναι ένας ιστός 80 ετών. Η γήρανση αυτή μειώνει συνεχώς τα ποιοτικά χαρακτηριστικά των κτιρίων. Αυτά ποτέ δεν κατασκευάστηκαν για να ζήσουν 200 χρόνια. Δεν υπήρχαν οι προδιαγραφές. Αν δεν περάσουμε σε μία λογική ενίσχυσης και σταδιακής αποκατάστασης του πολεοδομικού ιστού σε βάθος πολλών δεκαετιών είναι σίγουρο ότι αυτή η γήρανση δεν θα οδηγήσει σε καλή συμπεριφορά, όταν και όποτε γίνει ο επόμενος σεισμός. Επίσης, η πόλη έχει λιγότερους χώρους για να πάει ο κόσμος, είναι περισσότερο κτισμένη και επιβαρυμένη, άρα η διαχείριση του πληθυσμού είναι πολύ πιο δύσκολη» είπε.

Επίσης, αναφέρθηκε και στα ρήγματα – γνωστά και ενεργά – που βρίσκονται κοντά στην πόλη και δεν αποκλείεται να δώσουν νέους μεγάλους σεισμούς.

«Ξέρουμε ότι έχουν γίνει μεγαλύτεροι σεισμοί στην περιοχή μέχρι και 7 βαθμών (Θρακομακεδόνες) και ότι υπάρχουν ρήγματα πλησιέστερα στην πόλη, που μπαίνουν σχεδόν μέσα σε αυτήν, όπως το ρήγμα του Ανθεμούντα (που περνά μέσα από τον Θερμαϊκό και βγαίνει απέναντι στην Βεργίνα, όπου ενώνεται με το ρήγμα του Αλιάκμονα). Είναι ένα μεγάλο ρήγμα που πιθανώς συνδέεται με τον σεισμό του 1759, αλλά τότε δεν υπήρχαν καταγραφές. Ενα τέτοιο ρήγμα – που είναι πολύ πιο κοντά στην πόλη – μπορεί σαφέστατα να οδηγήσει σε σεισμούς, όχι μεγάλης διάρκειας, αλλά υψηλότερων επιταχύνσεων. Δεν θα πρέπει να νομίζουμε ότι ο σεισμός του '78 είναι το ταβάνι σε ότι αφορά την σεισμική επικινδυνότητα για αυτή την πόλη» τόνισε.

Ο πολιτικός μηχανικός και ομότιμος καθηγητής του ΑΠΘ, Γιώργος Πενέλης, θύμισε στην αρχή της εκδήλωσης ότι ο σεισμός του 1978 ήταν μεγέθους 6,5 βαθμών και σημειώθηκε 20 χιλιόμετρα ανατολικά της Θεσσαλονίκης (Βόλβη) σε εστιακό βάθος 8 χλμ, ενώ καταγράφηκε από τον επιταχυνσιογράφο που βρισκόταν στο ξενοδοχείο City – έναν από τους τέσσερις που διέθετε τότε η χώρα. Την εποχή εκείνη η πόλη είχε 66.000 κτίρια, εκ των οποίων το 65% κατασκευασμένα από οπλισμένο σκυρόδεμα. Μετά τον σεισμό – που είχε 49 νεκρούς και 220 τραυματίες – το 4,5% των κτιρίων χαρακτηρίστηκαν κόκκινα και το 21% κίτρινα.

(ΑΠΕ, 21 Ιουνίου 2018)

ΑΦΙΕΡΩΜΑ ΣΤΑ ΦΡΑΓΜΑΤΑ

Ποταμός της καθαρής ενέργειας

Τα έξι φράγματα του Αλιάκμονα δημιουργούν μοναδική συστοιχία λιμνών στην περιοχή

Στα σχολικά βιβλία ο ποταμός Αλιάκμονας είναι ο μεγαλύτερος σε μήκος ποταμός της Ελλάδας. Έχει τις πηγές του στον Γράμμο και τις εκβολές του στον Θερμαϊκό Κόλπο, διασχίζοντας πέντε νομούς. Στην αναθεώρησή τους τα σχολικά εγχειρίδια θα πρέπει τώρα να τον αναφέρουν ως τον ποταμό της καθαρής ενέργειας.

Στις 13 Ιουλίου, η ΔΕΗ προχώρησε στην έμφραξη της σήραγγας εκτροπής του φράγματος του υδροηλεκτρικού Έργου Ιλαρίωνα και ξεκίνησε έτσι η δημιουργία ενός νέου υδροταμιευτήρα που θα προσφέρει ύδρευση, άρδευση, τουριστική ανάπτυξη, αντιπλημμυρική ανάσχεση στους νομούς Κοζάνης και Γρεβενών και φυσικά καθαρή ηλεκτρική ενέργεια, αυξάνοντας κι άλλο το ποσοστό των πολύτιμων καθαρών πηγών ενέργειας στο εθνικό ενεργειακό χαρτοφυλάκιο. Ο Αλιάκμονας καλύπτει πλέον το 2%-2,5% στο συνολικό 8-10% της καθαρής ενέργειας που παράγει η χώρα κυρίως από τους υδροηλεκτρικούς σταθμούς του μεγαλύτερου σε μήκος ελληνικού ποταμού, του Αχελώου κι άλλων μικρότερων ποταμών της ηπειρωτικής Ελλάδας. Τα φράγματά του που έχουν κατασκευαστεί τα τελευταία 35 χρόνια δημιουργούν μια μοναδική συστοιχία λιμνών που ξεκινά από τις λίμνες του Μακροχωρίου και της Αγίας Βαρβάρας Ημαθίας και συνεχίζεται στις λίμνες των Ασωμάτων, της Σφηκιάς, του Πολυφύτου και τώρα αυτής του Ιλαρίωνα. Ίσως στο μέλλον κι αν η οικονομική κατάσταση της χώρας το επιτρέψει και η ΔΕΗ το κατορθώσει, να προστεθεί και η τεχνητή λίμνη Ελαφιού...

Λόγω του γεωανάγλυφου της περιοχής ή λόγω κάποιας μορφολογικής συγκυρίας και του σχεδιασμού της ΔΕΗ, η κάθε μια από αυτές τις τεχνητές λίμνες «βλέπει» την άλλη, με κυρίαρχη τη λίμνη του Πολυφύτου, έκτασης 74 τ. χλμ. τη μεγαλύτερη και μητρική λόγω κατασκευής του φράγματός της τη δεκαετία του '70. Άλλωστε, το νέο λιθόρριπτο φράγμα ύψους 130 μέτρων του Υδροηλεκτρικού Σταθμού Ιλαρίωνα συνολικού όγκου 9 εκατ. κ.μ. που θα δημιουργήσει τον ταμιευτήρα χωρητικότητας 520 εκατ. τ. χλμ. δεν απέχει παρά 2-3 χλμ. από τη ΝΔ όχθη της λίμνης Πολυφύτου, στη γέφυρα του Ρυμνίου Κοζάνης. Ο εξοπλισμός του ΥΗΣ Ιλαρίωνα περιλαμβάνει τον κύριο σταθμό που αποτελείται από δύο υδροστροβίλους συνολικής ισχύος 155,2 MW κι ένα μικρό υδροηλεκτρικό έργο για την εξασφάλιση της οικολογικής παροχής ισχύος 4,2 MW.

Η ισχύς του νέου ΥΗΣ Ιλαρίωνα Κοζάνης, σύμφωνα με στοιχεία που διέθεσε στην «Κ» ο τομεάρχης Λειτουργίας και Διαχείρισης Υδάτινων Πόρων της ΔΕΗ κ. Παναγιώτης Πεσεξίδης, θα προστεθεί σε αυτήν που παρέχουν στο ενεργειακό σύστημα της χώρας οι ΥΗΣ Πολυφύτου Κοζάνης με 420 GWH τον χρόνο (3 μονάδες των 125 MW), της Σφηκιάς Ημαθίας (3 μονάδες των 105 MW), των Ασωμάτων Ημαθίας (2 μονάδες των 55 MW), της Αγίας Βαρβάρας 940 KW και του Μακρυχωρίου Ημαθίας (3 μονάδες των 3,5 MW). Ο σταθμός Ιλαρίωνα προβλέπεται ότι θα παράγει ετησίως 330 GWH καθαρής ενέργειας συμβάλλοντας στην ανάπτυξη της ΔΕΗ και της εθνικής οικονομίας, στη διατήρηση της ποιότητας του περιβάλλοντος και της ασφάλειας ενεργειακού εφοδιασμού. Πάντως, η λειτουργία των ΥΗΣ του Αλιάκμονα δεν καθορίζεται από τις ενεργειακές ανάγκες της χώρας, αλλά από τις ανάγκες ύδρευσης, άρδευσης - αντιπλημμυρικής ανάσχεσης. Η παραγωγή ηλεκτρικής ενέργειας είναι τρίτη κατά σειρά στις παροχές των φραγμάτων, αλλά είναι αναμφίβολα πολύτιμος κρίκος στην ηλεκτροδότηση, λόγω της ταχύτατης ενσωμάτωσής τους στο ενεργειακό σύστημα της χώρας.

Τουριστικοί προορισμοί

Η Θεσσαλονίκη χρησιμοποιεί το 70% των αναγκών ύδρευσής της από τον Αλιάκμονα. Τα περισσότερα φράγματά του λειτούργησαν ευεργετικά στο περιβάλλον των νομών Ημαθίας και Κοζάνης. Ορισμένα από αυτά θεωρούνται «έργα ανθρώπων που συμπληρώνουν το έργο της φύσης». Η Αγία Βαρβάρα έξω από τη Βέροια καθίσταται τουριστικός προορισμός, ενώ η λίμνη Πολυφύτου Κοζάνης αναδεικνύεται σε οικολογικό παράδεισο-καταφύγιο πουλιών που προσφέρεται για τουρισμό.

Μια νέα λίμνη γεννιέται στο φράγμα Ιλαρίωνα

Η λίμνη Ιλαρίωνα (παίρνει το όνομά της από το μοναστήρι του Ιλαρίωνος της Αιανής Κοζάνης, δίπλα στο οποίο κατασκευάστηκε το φράγμα) είναι η νεώτερη λίμνη της χώρας. Μέχρι τα τέλη του χρόνου θα έχει ολοκληρωθεί ο σχηματισμός της.

Η περίοδος αυτή, όπως ανέφεραν οι υδρογεωλόγοι της ΔΕΗ, είναι και η πιο κρίσιμη για τον σχηματισμό μιας λίμνης και γι' αυτόν τον λόγο προηγούνται εκτεταμένες γεωλογικές και υδρογεωλογικές μελέτες στο έδαφος που θα καλύψει.

Κομβικό σημείο είναι ο ρυθμός που γεμίζει και σύμφωνα με τη ΔΕΗ η έμφραξη του φράγματος, ενώ η ανάπτυξή της εξελίσσεται σύμφωνα με τον σχεδιασμό.

Συνολικά η επιφάνεια των νερών της θα καλύπτει έκταση 21 τετραγωνικών χιλιομέτρων στα όρια των νομών Κοζάνης και Γρεβενών, αλλά είναι η τεχνητή λίμνη για την οποία έγιναν οι λιγότερες απαλλοτριώσεις, καθώς ο Αλιάκμονας σ' αυτήν την περιοχή, δηλαδή από τη Μονή Ιλαρίωνος μέχρι τη Μονή του Οσίου Νικάνορος Γρεβενών (Ζάβορδα), στο διάβα των αιώνων, έχει σχηματίσει βαθιές και απόκρημνες χαράδρες που τώρα θα προσφέρουν μεγάλο βάθος νερών.

Είναι η έκτη λίμνη που δημιουργείται κατά μήκος του ποταμού.

Μεταφορά εκκλησίας

Οι παραποτάμιες σωστικές ανασκαφές που έγιναν τα τελευταία χρόνια έφεραν στο φως σημαντικά στοιχεία για την προϊστορία της Μακεδονίας και τον μακεδονικό ελληνισμό, ενώ η ΔΕΗ διέθεσε κονδύλι 800.000 ευρώ για να μεταφέρει σε ράγες και σε νέα υψηλότερη θέση το παλιό μοναστήρι της Παναγίας Τουρνικίου Γρεβενών, προκειμένου να μην κατακλυστεί από τα νερά της.

Η υπέροχη διαδρομή που ενώνει τις αρχαιότητες της Βεργίνας με την Αιανή δημιουργεί τεράστιες δυνατότητες ανάπτυξης μοναδικού τουριστικού προϊόντος με πολυποίκιλο ενδιαφέρον, αναφέρει ο Δήμος Κοζάνης.

Τα νερά του νέου ταμιευτήρα σε μια εποχή που οι κλιματικές αλλαγές συνδέονται με προβλήματα λειψυδρίας θα συνιστούν πλεονέκτημα, αναφέρει ο δήμαρχος κ. Λάζαρος Μαλούτας και προσθέτει πως «ο Δήμος Κοζάνης θα παρακολουθεί την τήρηση των δεσμεύσεων της ΔΕΗ για την προστασία των μνημείων, αλλά και την εξέλιξη των εργασιών αποκατάστασης του φυσικού περιβάλλοντος στην περιοχή της Μονής Ιλαρίωνος ώστε να ξαναγίνει πόλος έλξης χιλιάδων τουριστών».

(Θανάσης Τσίγγανας / Η ΚΑΘΗΜΕΡΙΝΗ, 30.07.2012, http://portal.kathimerini.gr/4dcgi/_w_articles_kathglobal_1_01/08/2012_454464)

ΜΕΛΕΤΗ ΚΑΙ ΚΑΤΑΣΚΕΥΗ ΦΡΑΓΜΑΤΩΝ

Design and Construction Innovations

António Freitas da Costa, Maria Eugénia Resende, Manuel Alberto Oliveira, and Vítor Ribeiro

While developing the new 194.2-mw Venda Nova II pumped-storage project in Portugal, Energias de Portugal, S.A. used several innovative civil engineering techniques to design and build the power tunnels, support the powerhouse cavern roof, and excavate the upper surge shaft. These innovations helped EDP reduce construction time and cost for the project.

Development of the 194.2-mw Venda Nova II pumped-storage project in Portugal has provided owner Energias de Portugal, S.A. (EDP) with many opportunities to apply engineering innovations not previously used in the country. These innovations were used with the goal of reducing construction time and cost for the project. During design and construction of Venda Nova II, EDP:

- Used "unlined" tunnels for water conveyance in lieu of a traditional reinforced-concrete lining;
- Adopted an alternative method for supporting the roof of the powerhouse and transformer caverns; and
- Excavated shafts using a raise-boring technique instead of the traditional explosives method.

Background on the project

Venda Nova Dam, a 97-meter-high arch gravity dam on the Rabagão River, was completed in the early 1950s to impound water for the 135-mw Vila Nova powerhouse. A 2,650-meter-long high-pressure tunnel conveys water from Venda Nova Reservoir to an 820-meter-long penstock that feeds the three-unit powerhouse. In an average year, this powerhouse produces about 389 gigawatt-hours (gwh) of electricity. This powerhouse also receives inflow from Paradela Reservoir on the Cávado River. (See Figure 1) The powerhouse discharges its water into Salamonde Reservoir.

The Venda Nova II pumped-storage project takes advantage of about 420 meters of gross head between the Venda Nova and Salamonde reservoirs.

In 1996, EDP decided to build the Venda Nova II project, for two main reasons. First, in 1995 and 1996, the Portuguese Transmission System Operator, a division of the new Public Electricity System, predicted growth in demand for electricity of about 4.5 percent between 1996 and 2000 and 3.2 percent between 2001 and 2005. New power stations were needed to meet this projected growth in demand.

Second, the government of Portugal recognizes that more renewable energy is needed to reduce the country's dependence on fossil fuel generation. In line with Portugal's commitment to the Kyoto Protocol and the European Directive regarding the promotion of electricity generation from renewable energy, Portugal's goal is to have 39 percent of its electrical demand met by renewable energies by 2010. The country plans to meet this target through a combination of decommissioning old thermal stations and building new renewable energy stations.

Venda Nova II was designed to take advantage of about 420 meters of gross head, over a stretch of about 4,500 meters, between the Venda Nova and Salamonde reservoirs. Venda Nova II, which began operating in August 2005, has two reversible 97.1-mw turbine-generating units. Each unit consists of a Francis pump-turbine and a directly coupled synchronous motor-generator, supplied by Voith Siemens Hydro Power Generation. The project produces an annual average of about 220 gwh.

Innovations used at Venda Nova II

This article provides details about the three innovations mentioned earlier.

Using unlined tunnels

Traditionally, the design of hydro facilities in Portugal calls for reinforced concrete lining for underground water supply tunnels. This lining is intended to decrease roughness of the tunnel, protect against falling blocks, and provide waterproofing. However, for Venda Nova II, EDP looked at flexible support structures using fiber shotcrete and rockbolting, also known as "unlined" solutions. In this situation, the rock mass performs a structural function. To compensate for the increased roughness of the walls, the diameter of the tunnels is increased. This also allows for some blocks to fall, without concern for the carrying capacity of the tunnel. This concept is used in Norway.

EDP studied several options to integrate unlined tunnels at Venda Nova II. EDP understood that this concept could save construction time and cost. This unlined tunnel concept is associated with some specific design criteria: to guarantee low flow velocities (1 to 1.5 meters per second), to allow the fall of some rock blocks (units are protected by racks in sand-traps), and to avoid emptying of the system so as not to introduce unfavorable hydraulic gradients to the rock mass.

Based on the quality of the rock mass, four unlined sections were defined, as well as a rigid reinforced concrete-lined section. Total lengths for the rigid lining were around 7 percent in the headrace tunnel and 14 percent in the tailrace tunnel. Figure 2 shows the tunnel layout at Venda Nova II.

Figure 5 – Project overview

Several tunnels at the Venda Nova II pumped-storage project were left unlined, following a concept used in Norway. These include the headrace and tailrace tunnels, upper surge shaft, and access tunnel from the support building.

The option chosen consisted of:

- A 2.8-kilometer-long unlined headrace tunnel with a 15 percent slope and a 6.3-meter-diameter modified circular section, to connect the upper intake and powerhouse. The stretch upstream of the powerhouse is steel-lined and preceded by an upper sand trap;

- A 1.4-kilometer-long subhorizontal unlined tailrace tunnel with a 6.3-meter-diameter modified circular section, between the lower sand trap and lower intake;

- A 4.5-meter-diameter, 420-meter-long vertical unlined shaft to act as the upper surge tank, 500 meters upstream of the powerhouse, which empties into an expansion reservoir at the surface; and

- A 1.5-kilometer-long unlined access tunnel with an 11 percent slope and an 8-meter-diameter cross-section, also used to run the power and control cables from the transformers to the surface support building.

For unlined hydraulic tunnels, first filling is an important operation. During filling, the rock mass hydraulic conditions change because of the water pressures. This process, which results in filling of the fissures and voids in the rock mass, may induce leakage into the caverns and auxiliary tunnels and to the surface.

Before the tunnels were filled, EDP performed surveying to identify all infiltration points into the tunnels and caverns. A filling velocity was then defined, considering the geological and hydraulic conditions, to avoid any damages caused by high pore pressure.

To monitor the tunnels for leakage during first filling, EDP installed piezometers supplied by Tecnasol FGE and performed visual inspections of the most significant leakage points. Due to the very large water pressures in the headrace tunnel, EDP installed a high-precision digital manometer in the penstock, close to the protection valve in the powerhouse, to measure water level in the tunnel.

Filling started from the tailrace tunnel, which is shorter than the headrace tunnel and has a much lower final water pressure. This filling took place in one step.

Headrace tunnel filling was carried out through controlled periodic opening of the intake gate. The duration of opening was adjusted to control the rate of water level increase inside the tunnel (about 10 meters per hour in the first 250 meters and about 5 meters per hour in the last 150 meters). Monitoring steps were established at about 100 meters and later adjusted, depending on the behavior of the measured leakages. Leakages out of the headrace tunnel were evaluated by the water level variation inside the tunnel, using the manometer. When the leakages were considered acceptable and the rate was reduced with time, filling continued.

Supporting cavern roof and walls

For most hydro projects developed in Portugal prior to Venda Nova II, the practice for supporting the roof and walls of an underground cavern consisted of a cast-in-place reinforced concrete arch structure. However, EDP decided to use a support system consisting of cement-grouted rockbolts and fiber shotcrete. This is the same type of support structure used for the unlined tunnels.

This arrangement was possible because EDP considered the geotechnical characteristics of the rock mass during selection of the powerhouse location. The utility was looking for good overburden conditions, as well as compatibility with the most important geologic formations. To choose an approximate location, EDP drilled four 350-meter-long vertical boreholes from the surface. The utility then performed cross-hole seismic tomography (Lugeon) tests to define geologic conditions. In addition, EDP carried out laboratory tests on the samples to evaluate mechanical characteristics of the rock.

The field tests and displacements measured during the different excavation phases led EDP to the conclusion that the vertical stress in the powerhouse area was almost equal to the weight of the overburden. In addition, the horizontal stress normal to the powerhouse axis was about 2.5 times greater than the vertical stress. These values correlated closely with those accepted for the initial studies of this type of support structure for the cavern roof and walls.

The excavations of the powerhouse caverns were simulated, in the design stage, using the 3D numerical model FLAC3D, supplied by HCItasca. EDP used this model to evaluate the induced ground stresses, as well as the loads transmitted to the support system. Predicted displacements in specific points in the rock mass around the cavities for the powerhouse and transformer hall were used to control the real displacements measured by extensometers installed during excavation.

The powerhouse cavern for Venda Nova II is about 350 meters underground. It is 20 by 60 meters, with a maximum height of 40 meters. A smaller cavern adjacent to the powerhouse cavern contains two power transformers.

Excavation of the two caverns was performed in two stages:

- First, the vault was excavated using two side-drift tunnels with four transverse sections connecting these tunnels. The contractor installed extensometers in the transverse sections. Then the contractor completed excavation of the main cavern arch and installed the shotcrete and rockbolt support structure.

- Second, the contractor excavated the rest of the cavern using the bench blasting technique.

Using raise boring for shaft excavation

Excavation of the vertical shaft for the upper surge tank was a huge challenge because of its great height (420 meters). Because of concerns about the environment and construction safety, EDP decided that the excavation would be carried out by mechanical means, instead of using explosives.

The raise-boring technique adopted for this shaft at Venda Nova II involved opening a downward pilot borehole 0.3 meter in diameter, then reaming this borehole to the final diameter of 4.5 meters. The main civil works contractor, Consorcio Somague/Moniz da Maia Serra & Fortunato (MSF)/Mota & Companhia, performed this work.

A crucial aspect was to guarantee verticality of the pilot borehole axis, given its long length and its link to the headrace tunnel. The directional control system adopted, supplied by Edil-mac of Italy, featured a built-in drilling head with automatic position reading and self-correction equipment. This method proved very efficient, with a deviation of only 13.9 centimeters at the bottom of the borehole.

Other smaller shafts at Venda Nova II also were constructed using the raise boring technique. These include the vertical shaft of the lower surge tank, with a diameter of 5.6 meters and a height of 58 meters, and two slanted shafts connecting the powerhouse and transformer caverns to the ventilation and safety tunnel. These slanted shafts each are about 100 meters long and have diameters of 3.5 and 2.1 meters.

Results

Development of Venda Nova II began in 1997, with construction of roads and the access tunnel to the powerhouse. The main civil works began in mid-2000 and were completed in 2004. The project began generating electricity in August 2005.

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Comparing Faced Symmetrical Hardfill and Concrete-Faced Rockfill Dams

Mohammad Esmaeilnia Omran and Hamed Mahdiloo Torkamani

With both faced symmetrical hardfill and concrete-faced rockfill dams being suitable for sites with poor foundations, the authors set out to determine unique characteristics of the two dams types. Their research revealed a smaller amount of deformation and lower costs for FSHDs.

The first and most important step in designing a new dam is determining an appropriate type of dam to build, based on the unique site conditions. The optimal design of the dam is determined after consideration of technical, economic, environmental and social factors.

For sites with poor foundations, trapezoid-shaped dams are good options because they typically have a much greater weight than conventional gravity dams and therefore do not require the high shear strength of bedrock to satisfy requirements for safety against sliding. Both faced symmetrical hardfill dams (FSHD) and concrete-faced rockfill dams (CFRD) have symmetrical trapezoid-shaped cross sections with an upstream concrete face slab that prevents water from penetrating into the dam body.

In this article, the authors evaluate the properties of FSHD and CFRD. Static and dynamic analyses for both dam types were performed using finite element analysis software, and safety was evaluated for static and dynamic loads. Finally, both dam types are evaluated and compared technically and economically.

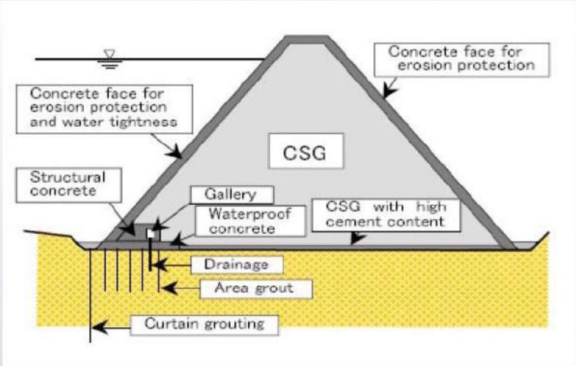
The results show that FSHD and CFRD are safe against applied loads, but the deformation obtained in FSHDs is smaller than that for CFRDs. Also, FSHDs are more economical to build than CFRDs for sites with high flooding in the river.

Understanding these dam types

FSHD is a fairly new type of dam, first proposed in 1992,[1,2] which is called CSG (cemented sand and gravel) in Japan. This type of dam is built using a low-cost cemented sand and gravel material known as hardfill. A FSHD has several advantages, including a high degree of safety, strong earthquake resistance, low demands for the foundation, simple and quick construction and minimal negative effects on the environment.

Because of its trapezoid shape, a hardfill dam has much greater weight and a longer length for shear resistance than does a conventional gravity dam (see Figure 1). It is said the high shear strength of the dam foundation is not required to satisfy safety requirements against sliding, meaning this type of dam can be constructed even on a poor foundation.[3]

FIGURE 1 Cross Section of Hardfill Dam



A hardfill dam, with its trapezoid shape, has much greater weight and a longer length for shear resistance than a conventional gravity dam, making it suitable for sites with questionable foundations.

CFRDs are popular all over the world, especially in regions that receive heavy rain and where impervious clay is insufficient. CFRD has become popular over the past 40 years because of its good performance and low cost compared with rockfill dams with an inner earth core.

A chronicle of modern rockfi ll dam design, including a description of current practice in CFRD design, is available,4 as are explanations of the characteristics of rockfill behavior using specific CFRD cases.[5,6] It is often necessary to rely on historic performance data from other dams to estimate dam properties. In recent years, a significant amount of research has been performed with regard to the properties, design, construction and behavior of CFRDs.

There are several examples of CFRDs built worldwide, including New Exchanger, a 155 meter-high dam built in the USA in 1967; Aguamilpa, a 187 meter-high dam built in Mexico in 1993; and Shuibuya, a 233 meter-high dam built in China in 2008.

Finite element models of FSHD and CFRD

The authors performed finite element modelling of FSHDs and CFRDs to evaluate safety of both dam types against applied loads. To supply the general properties of the dam - geometry, material properties of the foundation, dam height and reservoir level - the authors chose a profile of the Kahir Dam site for both models (see Tables 1 and 2 for more information on the two dam types studied).

Table 1 – Geometric Properties of FSHD and CFRD Models

Properties	FSHD	CFRD
Dam height	48.5 m	48.5 m
Width of dam crest	4.0 m	10.0 m
Width at base of dam	71.9 m	165 m
Length of dam crest	378 m	378 m
Level of reservoir	42.5 m	42.5 m
Slope in upstream and downstream	0.7H:1V	1.6H:1V
Concrete face	0.45 m	0.45 m

Table 2 – Material Properties of Finite Element Models

Properties	Hardfill (FSHD)	Rockfill (CFRD)	Concrete face	Foundation
Unit weight (kg/m³)	2,400	2,100	2,400	-
Poison's ratio	0.2	0.25	0.18	0.3
Modulus of elasticity in static case (MPa)	12,000	210	28,000	1000
Modulus of elasticity in dynamic case (MPa)	15,000	250	28,000	1250
Cohesion (KPa)	-	1.0	-	-
Internal friction (degree)	-	45	-	-

Kahir Dam, located on the Kahir River in southeastern Iran, will be the first FSHD constructed in the country, and this work is scheduled to begin in 2012. The dam is 68 meters high, with a width at the dam crest of 4 meters and width at the base of 71.9 meters. The upstream and downstream slope of this dam is 0.7H:1V. The river basin area at the Kahir Dam site is equal to 4,596 km2. And average annual rainfall in the basin is 150 mm.[7]

Modeling of the FSHD was performed using ANSYS finite element analysis software.[8] A two-dimensional FEM model was built for static and dynamic analysis. The solid structural element PLANE 82 is used for the dam body (hardfill), concrete face and foundation. This is an eight-node element. A contact element is adopted to simulate the element between the dam body and concrete face. This FEM model has plane-strain behavior. Also, the dam body, concrete face and foundation were assumed as elastic material.

Modeling of the CFRD was performed using PLAXIS finite element software.[9] A 2D FEM model was built for static and dynamic analysis. A six-node element was used for the dam body (rockfill), concrete face and foundation. The element between the dam body and concrete face is a contact element. This FEM model has plane-strain behavior. Also, the concrete face and foundation were assumed to be elastic material, and the model of the dam body (rockfill) is a Mohr-Coulomb (plastic) model.

Loads applied in the static and dynamic analysis of the FEM models for both dam types are:

- Weight of the dam body;
- Hydrostatic pressure of the reservoir water on the upstream dam surface;
- Uplift pressure at the base of the dam;
- Inertia force of the dam body from upstream to downstream (dynamic load); and
- Hydrodynamic pressure on the upstream side of the dam.

The earthquake coefficient for both dams was considered to be 0.15.

Technical evaluation of FSHD and CFRD

The maximum deformations in the dam body and concrete face under dynamic loads for a FSHD are much smaller compared with the CFRD: the maximum horizontal and vertical deformations are 1:11 and 1:14. In this condition, the facing safety for a FSHD is better than that for a CFRD.

Table 3 shows the principle stress and safety factor for a FSHD. Safety factors for stress distribution in the body of a FSHD for the static and dynamic load cases are considered to be 3 and 1.5, respectively.10 Tensile and compressive stresses in the dam body are much less than allowable stresses. As a result, the dam is in the safe condition. Also, for construction of a FSHD, hardfill materials with low cement strength can be used.

Table 3 – Principle Stress and Safety Factor for FSHD

Item	Dam body stress	Allowable stress	The principle stress and safety factor for FSHD Safety factor
Tensile stress (Mpa)	0.694	1.5	2.16
Compressive stress (Mpa)	-3.44	-15	4.36

In the FEM model of a CFRD, tensile and compressive stresses distributed in the dam body are very low. Maximum tensile and compressive stresses created in the dam body are -0.5 MPa and 0.3 MPa, respectively. As a result, the dam is in the safe condition.

The formula for the local safety factor against sliding at the base of the dam is:[3]

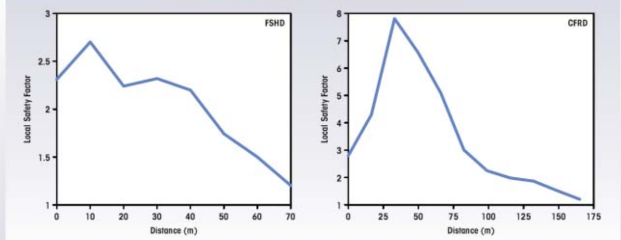
Equation 1 $K = (\Sigma\sigma \times f + c \times A) / \tau$

where:

- σ is normal stress in the vertical direction at the base of the dam;
- f is friction against shearing;
- c is cohesion against shearing;
- A is the width of the dam base; and
- τ is shear stress at the base of the dam.

Safety factors against sliding at the base of a FSHD and a CFRD are 2.1 and 3.25, respectively. Figure 2 shows the distribution of local safety factors against sliding at the base of a CFRD and FSHD, respectively. From the viewpoint of structural stability, it can be seen that a CFRD has greater safety factor than the FSHD because a CFRD has much bigger weight and longer length for shear resistance than a FSHD. According to the safety factor result, the safety against sliding of a CFRD is about 50% more than a FSHD, but both dams are safe against sliding.

FIGURE 2 Safety against Sliding at Base of FSHD and CFRD



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Economical evaluation of FSHD and CFRD

In this section, FSHDs and CFRDs are evaluated economically. For this purpose, both of the FEM models in the previous section were considered as sample cases for economic evaluation.

From an executive point of view, the six most important aspects of dam construction are:

- Water diversion system;
- Excavation of foundation and abutment of the dam and modification as needed;
- Construction of cutoff wall;
- Construction of dam body;
- Construction of spillway; and
- Instrument installation.[10]

With the dam site for both FSHD and CFRD being essentially the same, the executive items and associated costs are equal. The second and third items are the same for both dam types.

Design of a water diversion system for rockfill and earth dams is based on the seven- to 10-year flood return periods, whereas roller-compacted-concrete (RCC) dams are based on three- to five-year flood periods. This is because the construction period for rockfill dams is longer than for RCC dams. Thus, the cost of a water diversion system for CFRD is more than for FSHD.

Costs for excavation of the foundation and abutment and construction of a cutoff wall are considered identical.

Construction of the dam body and spillway for FSHDs and CFRDs are different. The amount of materials used in the dam body and concrete face was 696,654 m^3 of hardfill for the FSHD and 1,604,138 m^3 of rockfill for the CFRD, along with 15,564 m^3 and 10,070 m^3 for the concrete face of the CFRDs and FSHDs, respectively.[11]

Using the above numbers, the total cost of dam body and facing construction for FSHDs and CFRDs has been calculated. The total cost of a FSHD is $14,537,820, with $13,933,080 for the dam body and $604,200 for the concrete face. The total cost of a CFRD is $11,360,737, with $10,426,897 for the dam body and $933,840 for the concrete face (see Table 4).

Table 4 – Material Costs for FSHD and CFRD

	FSHD Materials (in m³)	CFRD Materials (in m³)	Unit Prices	Total Cost
Hard-fill	696,654	-	$20	$13,933,080
Rock-fill	-	1,604,138	$6.5	$10,426,897
Concrete face	10,070	-	$60	$604,200
	-	15,564		$933,840

In the above costs, the cost of the spillway is not included. For CFRDs, the spillway is constructed separately from the dam body, and its costs are about 30% to 35% of the total cost of the dam. For FSHDs, the spillway is constructed on the dam body and the spillway costs are very low, only about 5% of the total cost of dam construction.[11] Thus, in general, CFRD costs are greater than FSHD costs.

Summary and conclusions

FSHDs and CFRDs were evaluated technically and economically and compared with each other. Based on the above technical and economical evaluation, the authors have drawn the following conclusions:

- FSHD, a new type of RCC dam with a shape between a gravity dam and CFRD, has good quality and some unique advantages such as high safety, strong earthquake resistance, low demands for foundation, simple and quick construction, low cast and small negative effects on the environment.
- CFRD has a symmetrical trapezoid-shaped cross section with a concrete face slab on the upstream side that prevents water penetration into the dam body. This type of dam is suitable for sites with alluvial foundation and gravel materials and especially in regions that receive heavy rain and where impervious clay is insufficient.
- Results show that deformations at the dam body and concrete face of FSHDs are smaller than deformations for CFRDs.
- The maximum horizontal and vertical deformations at FSHD dam body are 1:11 and 1:14, respectively.
- Results obtained from the analysis show that tensile and compressive stresses in the bodies of both dam types are much less than allowable stresses, and both of the dam types are in the safe condition.
- Hardfill materials with low cement and lower strength can be used for the construction of FSHD.
- The safety factor against sliding of CFRD is about 50% more than FSHD, but both dams are safe against sliding.
- Evaluating the total costs of dam construction — including the cost of the diversion system, dam body, facing and spillway construction — one can see the total construction costs of FSHD is less than CFRD.
- Construction of FSHD on sites located on seasonal rivers with high floods is a better option than CFRD because during unexpected seasonal floods, FSHD has a greater safety factor than CFRD.

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ΦΡΑΓΜΑΤΑ ΑΠΟ ΣΚΛΗΡΑ ΕΠΙΧΩΜΑΤΑ ΚΑΙ ΚΥΛΙΝΔΡΟΥΜΕΝΟ ΣΚΥΡΟΔΕΜΑ

RCC arch dams: temperature control and design of joints

Bofang Zhu

THE CONSTRUCTION technology of an RCC arch dam is similar to that of RCC gravity dams. The main difference between these two types of RCC dams is the temperature control and design of joints. Sections of gravity dams are stable on their own, so transverse joints without grouting may be adopted in gravity dams to release the restraint to thermal deformation in the axial direction of the dam. The height of region of remarkable foundation restraint to thermal deformation in the direction of the river is about 0.20L, where L is the width of the base of the dam. Thus, if the concrete of the lower part of the dam subjected to severe foundation restraint is poured in the months of lower temperature of a year, the temperature control of the upper part of the gravity dam is not difficult.

On the other hand, the water loads on an arch dam are transferred to the abutments by the horizontal arch action, the safety of an arch dam relies on the continuity through the dam, and so transverse joints without grouting are not permitted in an arch dam. The thermal deformations are restrained by the foundation rock on the two sides from the base to the top of the dam. If concrete is poured in warm months, remarkable thermal stresses and cracks may be induced in the dam.

There are no transverse joint but only some crack inducers in the first three RCC arch dams constructed in the world (Kuellpoort and Wolwedans dams in South Africa and Puding dam in China). After a thorough study of this problem, in 1992, the author pointed out that grouted transverse joints and relevant temperature control generally are necessary to RCC arch dams except the small ones constructed in winter months, and suggested that transverse joints may be made by precast concrete and the dam can be cooled by water flowing in embedded pipes (Zhu 1992).

Thereafter, transverse joints grouted after proper cooling are generally adopted in RCC arch dams in China. The method for computing the temperature loads, the method for control of thermal stresses and the principles for design of joints for RCC arch dams are given in the following paper.

RCC arch dams without transverse joint

In warm regions, such as the south of China, because the final qusi-stable temperature of the dam is high, a small RCC arch dam can be constructed in the winter months. In this case, the temperature drop of the concrete is not great and there will be possibly no cracking if the dam is constructed without transverse joint. It will be shown how to analyse this possibility in the following.

As shown in Figure 1, the temperature in the section of a dam at any time can be divided into three parts: the mean temperature T_m, the equivalent linear temperature difference T_d and the nonlinear temperature difference T_n as follows:

$$T_m = \frac{1}{L}\int_{-L/2}^{L/2} T(x)\mathrm{d}x \qquad (1)$$

$$T_d = \frac{1}{L^2}\int_{-L/2}^{L/2} T(x)\mathrm{d}x \qquad (2)$$

$$T_n = T(x) - T_m - T_d\, x / L \qquad (3)$$

where L is the thickness of the dam.

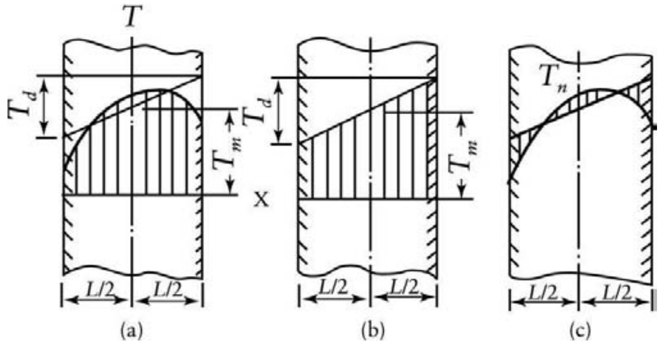


Figure 1

The nonlinear temperature difference T_n is an important factor leading to superficial cracks but it does not affect the displacements and internal forces of the dam, therefore, only mean temperature T_m and equivalent linear temperature difference T_d are considered in the stress analysis of arch dam in the Design Specifications for Concrete arch dams in China.

For an arch dam without transverse joints, the temperature loads may be computed by the following formulas

$$\left.\begin{aligned} T_m &= T_{m1} - T_{m0} \pm T_{m2} \\ T_d &= T_{d1} - T_{d0} \pm T_{d2} \end{aligned}\right\} \qquad (4)$$

where T_m and T_d are the mean temperature and the equivalent linear temperature difference for computing thermal stresses in the arch dam; T_{m0} and T_{d0} are the highest mean temperature and equivalent linear temperature difference in the process of construction; T_{m1} and T_{d1} are the mean temperature and equivalent linear temperature difference (along x axis) of the annual mean temperature in the period of operation; T_{m2} an $T_{d2}$are the mean temperature and equivalent linear temperature difference induced by the variation of the water temperature on the upstream face and the air temperature on the downstream face.

As shown in Figure 2, the annual mean temperature of the upstream face of the dam is equal to the annual mean temperature of the water in the reservoir, which can be expressed as follows (Zhu 1997)

$$T_{\mathrm{um}} = c + (b - c)e^{-0.04y} \qquad (5)$$

in which $c = (Tb - bg)/(1 - g)$, $g = e^{-0.04H}$, where y is the depth of water, m; H is the depth of the reservoir, m; T_b is the water temperature at the bottom; b is the annual mean water temperature at the surface of reservoir; T_{um} is the annual mean water temperature at depth y.

The annual mean temperature of the downstream face of the dam is given by the following equation

$$T_{\mathrm{dm}} = T_{\mathrm{ma}} + \Delta\mathrm{T} \qquad (6)$$

where T_{ma} is the annual mean air temperature, ΔT is the increment of mean temperature of downstream face due to solar radiation. The mean temperature of the downstream face below the tail water may be computed by an equation similar to equation 5.

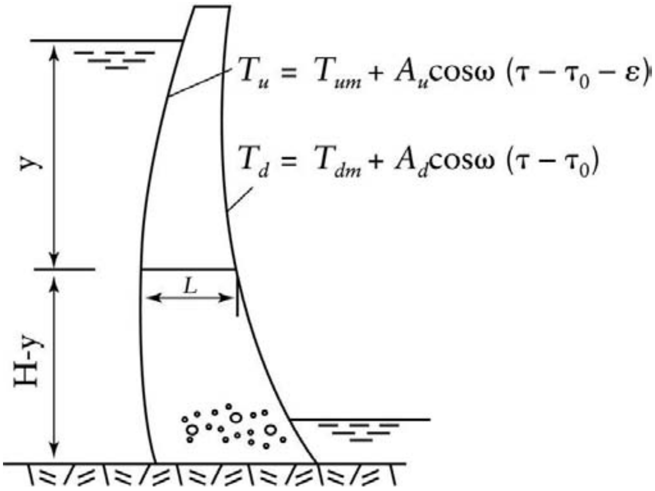


Figure 2

Because arch dams are generally not very thick, the distribution of annual temperature along the thickness is practically linear, so the mean temperature T_{m1} and equivalent linear temperature difference T_{d1} (along x axis) of the annual mean temperature in the period of operation may be computed as follows

$$\left.\begin{aligned} T_{m1} &= \tfrac{1}{2}\left(T_{\mathrm{dm}} + T_{\mathrm{um}}\right) \\ T_{d1} &= \tfrac{1}{2}\left(T_{\mathrm{dm}} + T_{\mathrm{um}}\right) \end{aligned}\right\} \qquad (7)$$

If no special measures are taken, the distribution of temperatures in the direction of thickness of the dam is generally symmetrical, so the equivalent linear temperature difference

$$T_{d0} = 0 \qquad (8)$$

The maximum mean temperature of concrete in the process of construction is given by

$$T_{m0} = T_p + k_r T_r \qquad (9)$$

in which T_p is the placing temperature of concrete, T_r is the maximum temperature rise due to heat of hydration of cement, k_r is a coefficient of reduction considering the influence of the compression due to the temperature rise in the early age which will offset a part of the tensile stress induced by the temperature drop in the later age of concrete. k_r is approximately equal to 0.70~0.85. To be on the safe side, we may take k_r =1.0, then

$$T_{m0} = T_p + T_r \qquad (10)$$

Let the adiabatic temperature rise of concrete be given by

$$\theta(\tau) = \theta_0\left(1 - e^{-\mathrm{m}\tau}\right) \qquad (11)$$

where t is age of concrete (d); m is a constant and θ_0 is the final adiabatic temperature rise.

For a RCC dam with thickness L, considering the loss of heat from the two lateral sides as well as from the surface of lift, the maximum mean (across the thickness) temperature rise due to heat of hydration may be given by the following formula:

$$T_r = sN\theta_0 \qquad (12)$$

where N is the coefficient of heat loss from the two lateral sides, given by a theoretical solution (Zhu 1999); s is the coefficient of heat loss from the surface of lift, given by numerical method, the value of s primarily depends on the rate of rising of the dam concrete. N and s may be found from Figure 3 & 4.

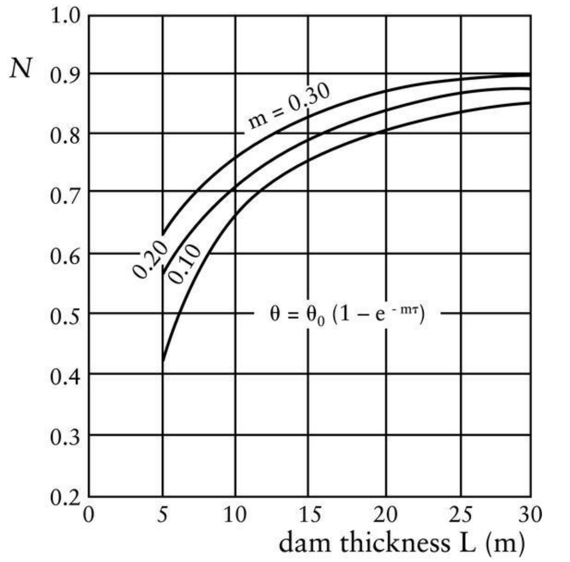


Figure 3

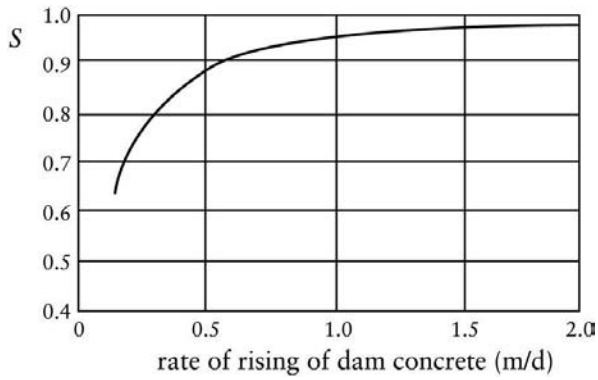


Figure 4

As shown in Figure 2, the temperature of the upstream face of the dam is given by (Zhu 1997)

$$T_u(y,\tau) = T_{\mathrm{um}}(y) + A_u(y)\cos\omega(\tau - \tau_0 - \epsilon) \qquad (13)$$

where t is time; y is the depth of water; $T_{um}(y)$ is the annual mean temperature of water; $A_u(y)$ is the amplitude of annual variation of water temperature; t_0=6.5 month is the time of maximum air temperature; e is the phase difference between the maximum temperatures of water and air; ?=2? /P, P=12 month is the period of variation of temperature.

T_{um} is given by Equation 5 and A_u is computed as follows:

$$A_u = A_0 e^{-0.018y} \qquad (14)$$

where A_0 is the amplitude of annual variation of the water temperature at the surface of reservoir (y =0). The temperature of the downstream face of the dam is given by

$$T_d(y,\tau) = T_{\mathrm{dm}}(y) + A_d(y)\cos\omega(\tau - \tau_0) \qquad (15)$$

The mean temperature T_{m2} and the equivalent linear temperature difference T_{d2} induced by the annual variation of water temperature on the upstream face and air temperature on the downstream face are computed as follows:

$$T_{m2} = k_m\left[A_d(y)\cos\omega(\tau-\tau_0-\theta_m) + A_u(y)\cos\omega(\tau-\tau_0-\epsilon-\theta_m)\right] \quad (16)$$

$$T_{d2} = k_d\left[A_d(y)\cos\omega(\tau-\tau_0-\theta_d) - A_u(y)\cos\omega(\tau-\tau_0-\epsilon-\theta_d)\right] \quad (17)$$

in which

$$k_m = \frac{1}{2\eta}\sqrt{\frac{2(\mathrm{ch}\eta-\cos\eta)}{\mathrm{ch}\eta+\cos\eta}},$$

$$\theta_m = \frac{1}{\omega}\left[\frac{\pi}{4} - \tan^{-1}\left(\frac{\sin\eta}{\mathrm{sh}\eta}\right)\right],$$

$$k_d = \sqrt{a_1^2 + b_1^2}, \quad \theta_d = \frac{1}{\omega}\tan^{-1}\left(\frac{b_1}{a_1}\right)$$

$$a_1 = \frac{6\sin\omega\theta_m}{k_m\eta^2},$$

$$b_1 = \frac{6}{\eta^2}\left(\frac{6}{\eta^2}\cos\omega\theta_m - 1\right),$$

$$\eta = L\sqrt{\frac{\pi}{aP}}, \quad \omega = \frac{2\pi}{P} \quad (17a)$$

where a is the thermal diffusivity of concrete, and P=12 month.

For example, as shown in Figure 5, the height of dam is 75m, the thickness at top is 6m and the thickness at base is 30m. The final adiabatic temperature rise ?0=18°C, the coefficient of rate of heat hydration m=0.15 (1/d), the rate of rising of dam concrete is 0.50 m/d, from figure 4 s=0.89, N is given in Figure 3.

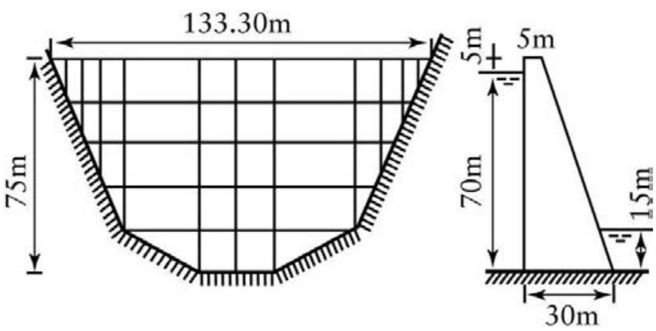


Figure 5

The annual mean air temperature is 14.7°C, the increment of temperature due to solar radiation is 3°C, so the annual mean temperature of the downstream face of dam is T_{dm}=17.7°C. The annual mean temperature of water at the surface of reservoir is 16.7°C, from Equation 5, the annual mean water temperature at the upstream face of dam is given by

$$T_{um} = 11.62 + 5.08e^{-0.04y} \quad (18)$$

The amplitude of annual variation of water temperature is

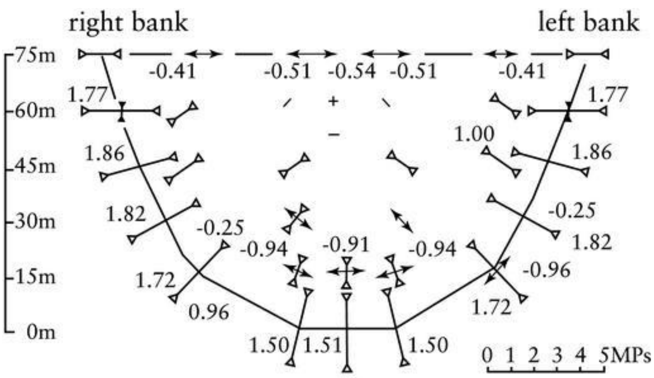
$$A_u = 9.55e^{-0.018y} \quad (19)$$

The temperature loads of the dam are computed by Equations 4, 7, 10, 16 and 17 and the results of computation are given in Table 1.

For the loading case: water pressure + weight + temperature loads in winter, the dam is analyzed by the program ADASO (Arch Dam Analysis System and Optimization) (Zhu et a1. 1991). The stresses are shown in Figure 6. The maximum tensile stress is 1.05MPa, which is less than the allowable tensile stress 1.20MPa, stipulated in the Design Specifications of Concrete Arch Dam of China. Although there is no transverse joint in the dam, as the dam is constructed in winter months, the thermal stresses are small, so it is possible that there will be no cracking. To be on the safe side, some crack inducers may be set up in the dam. It is necessary to use superficial insulation and curing in the process of construction to prevent cracking due to cold wave and drying shrinkage.

Table 1 Temperature loads for a RCC arch dam

Elevation (m)	0	15	30	45	60	75
Thickness (m)	30.0	25.2	20.4	15.6	10.8	6.0
Coefficient N	0.870	0.855	0.825	0.770	0.710	0.530
Temperature rise T_r (°C)	13.94	13.70	13.21	12.33	11.37	8.49
Placing time	Dec.	Dec.	Jan.	Jan.	Feb.	March
Placinq temp T_p (°C)	6.7	6.7	5.0	5.0	6.7	11.6
$T_{m0}=T_p+T_r$	20.64	20.4	18.21	17.33	18.07	20.09
T_{d0}	0	0	0	0	0	0
T_{m1}	13.70	14.44	15.17	15.60	16.37	17.20
T_{d1}	2.47	4.52	5.06	4.21	2.67	1.00
T_{m2}	0.794	1.054	1.360	1.939	3.586	8.141
T_{d2}	1.962	3.855	4.205	4.160	2.346	0
Temperature loads in winter (°C) T_m	-7.73	-7.01	-4.40	-3.67	-5.29	-11.03
T_d	0.51	0.67	0.86	0.05	0.32	1.00
Temperature loads in summer (°C) T_m	-6.15	-4.91	-1.68	+0.21	1.89	5.25
T_d	4.43	8.38	9.27	8.37	5.02	1.00



(a)

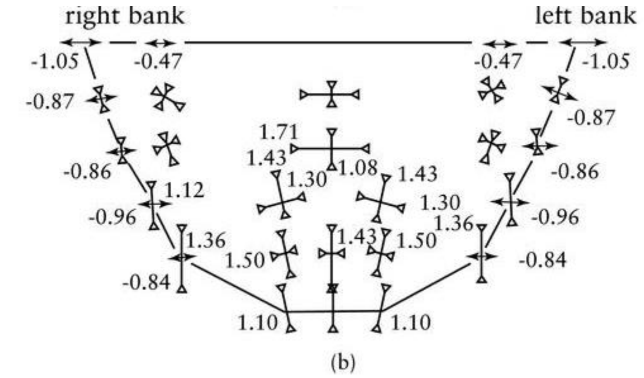


Figure 6

RCC arch dams with transverse joints

If the dam concrete can not be poured in winter months, or the dam site is located in a cold region where the final mean temperature of the dam is low, the inevitable big temperature difference will induce remarkable cracking. In this case, it is necessary to adopt transverse joints grouted after proper cooling in the dam.

Firstly, it is suggested to pour the concrete in lower part of the dam in winter months to the greatest extent so as to increase the height H_1 of the part of dam without joint as great as possible (Figure 7). Transverse joints are necessary in the part above H_1because the temperature differences are big. As RCC generates less heat of hydration, the distances between transverse joints may be somewhat greater than those in conventional concrete arch dams. According to the length of the crest of dam, there may be 1~4 transverse joints, as shown in Figure 7. Some steel reinforcements must be put beneath the lower end of the joint standing on concrete to prevent the joint from extending downward in the course of cooling of the dam.

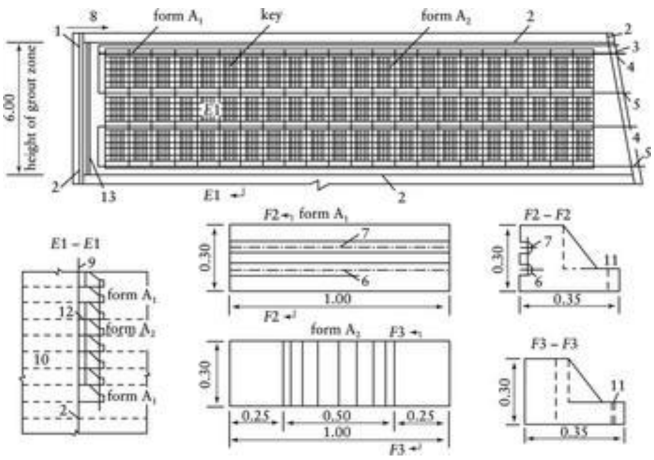


Figure 7

Cooling of the dam before joint grouting

Before grouting of the transverse joints, the dam must be cooled to predetermined temperature; for example, the mean temperature of the dam must be not higher than the annual mean temperature of the dam in the period of operation.

This requirement may be fulfiled by natural cooling when the thickness of the dam is small; otherwise, artificial pipe cooling must be used. In Shuikou RCC gravity dam, steel cooling pipe had been used (Chen 1991). In the cofferdam of Dachaoshan dam, a RCC arch dam, PVC cooling pipe had been used successfully (Chen 2002). PVC cooling pipe is more suitable than steel pipe, because PVC pipe has less connections and it is so flexible that it can be installed easily before pouring of concrete.

If the reservoir can be emptied of water in the period of operation, instead of cooling pipe, the repeated grouting system may be used to grout the transverse joints after the dam concrete having been cooled, but there are some uncertainties in this case, for example, if the water level is high in the process of natural cooling of dam, remarkable tensile stresses may appear in the dam which will induce cracking and worsen the stress state of the dam.

Crack inducers

Crack inducers reduce the effective area of the cross-section of the dam. When the tensile stresses in other part are not higher than those acting on the section of crack inducers, they will open; otherwise, cracks may appear in other part of the dam and crack inducers will not open, as in Puding RCC arch dam.

When the dam is thick, a long time is required for the temperature in the dam to fall to the final quasi-steady temperature. Under the simultaneous action of the water pressure and temperature drop in the process of natural cooling of dam, the axial force of the arch is generally compressive (except the upper part of the dam), the stresses will be tensile on one side and compressive on the opposite side, so it is impossible for the full section to open and the stress state in the dam may be worsened.

The action of crack inducers is different from that of transverse joints, which are grouted after the dam having been fully cooled. Thus crack inducers can be used only as auxiliary measures and not as principal measures to control cracking in RCC arch dams.

Construction of transverse joints

The author proposed to use precast concrete to form transverse joints in RCC arch dam (Zhu 1992). This idea was realised and developed in the design of Shapai RCC arch dam (Chen 2002). As shown in Figure 8, the transverse joint is formed by a series of pairs of gravity type precast concrete forms with length of 1.00m and height of 0.30m, which is equal to the thickness of layer of concrete. The height of grouting zone is 6.0m.

There are two types of forms: A1 and A2. The grouting system is installed in form A1 and the keys of joint are in form A2. In the process of construction of dam, the precast concrete forms are installed before the pouring of concrete.

The dam is cut by transverse joints, which are grouted after the dam concrete having been cooled to predetermined temperature. The structural action of transverse joints is clear and reliable.

Conclusions

In the warm region, the final quasi-stable temperature of the dam is high. A small RCC arch dam can be constructed in winter months, so the temperature drop of the dam concrete is not great and it is possible that there will be no cracking if the dam is constructed without transverse joint.

If the dam cannot be constructed in winter months or the dam site locates in cold region where the final mean temperature of the dam is low, it is necessary to adopt transverse joints grouted after proper cooling of the dam. The joints may be formed by precast concrete blocks with height 0.30m which is equal to the thickness of layer of concrete.

If the dam is thin, it may be cooled to predetermined temperature by natural cooling, otherwise, PVC cooling pipe may be used which is convenient for RCC.

Source: Bofang Zhu, China Institute of Water Resources and Hydropower Research, Beijing, China

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(International Water Power and Dam Construction Online, 31 August 2006, http://www.waterpowermagazine.com/news/newsrcc-arch-dams-temperature-control-and-design-of-joints)

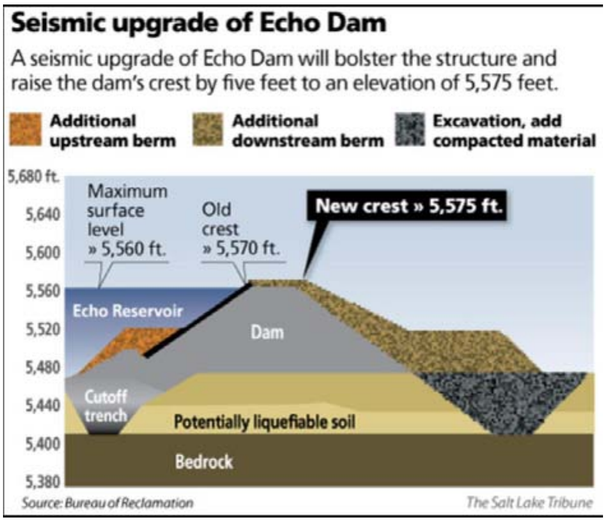
ΕΝΙΣΧΥΣΗ ΦΡΑΓΜΑΤΩΝ

Crews bracing Echo Dam for quakes
$50 million upgrade will help protect Morgan County downstream

Echo Dam is 82 years old, and it's getting a makeover — a $50 million seismic nip and tuck.

Studies beginning in 1998 revealed that the 158-foot-high earthen dam along the Weber River in northeastern Summit County is sitting atop a "liquefaction" zone, where soils can become unstable during an earthquake, said Curtis Pledger, Provo area manager for the federal Bureau of Reclamation.

The zone is on the dam's downstream side, where crews began excavating in early June. They will dig down to bedrock, removing about 665,000 cubic yards of soil and gravel and refill the excavated area with what Pledger described as "stable material" that will not liquefy in a temblor.



All told, Pledger said, the crews will end up stabilizing the dam with 1.2 million cubic yards of material.

The spillway also will be reconstructed by the project's finish date in September 2014.

Seismic studies now show that a 4.5 magnitude quake along the Main Canyon Fault could cause soils beneath the dam to "sag," leading to a failure that most likely would result in the loss of life and property downstream, particularly in Morgan County.

Crews also will construct berms abutting both sides of the dam that will allow it to withstand a 6.5 magnitude quake on the nearby Main Canyon Fault, which runs between Henefer and East Canyon. That would be equivalent to a 7.5 farther away on the Wasatch Fault in the Salt Lake Valley.

When full, Echo Reservoir holds 74,000 acre-feet of water. If the project did not go forward, the Bureau of Reclamation would allow the Weber River Water Users Association — which owns and operates the dam — to fill the reservoir to only 56 percent of capacity, said Manager Ivan Ray.

"That would not take care of all our downstream demand," Ray said, "particularly in a dry, hot year like this one."

The reservoir is now dropping 12 inches per day due to demand

(Christopher Smart / The Salt Lake Tribune, July 16 2012, http://www.sltrib.com/sltrib/news/54497009-78/dam-crews-downstream-echo.html.csp)

ΑΣΤΟΧΙΕΣ ΦΡΑΓΜΑΤΩΝ

National Geographic Documentary 2016
Top 15 Worst Dam Disasters Ever

Αναφέρεται σε αμερικανικά φράγματα που είτε αστόχησαν, είτε η αστοχία τους μπορεί να προκαλέση σοβαρές καταστροφές και απαιτούν ενίσχυση.

https://www.youtube.com/watch?v=7yVy_lMCRMg

Vajont Dam
Seconds from Disaster - Mountain Tsunami

In 1960 construction of Europe's tallest dam is completed in the Vajont Valley in Northern Italy - the jewel in the crown of an ambitious hydro-electric generation scheme. But as the new reservoir fills, a vast section of mountainside is dislodged and creeps towards the lake. The power company know the landslide has the potential to cause a devastating tsunami if it hits the water at speed, so they develop a plan to ease the landslide down by adjusting the level of the lake. For two years there are no problems, but in October 1963, the landslide suddenly accelerates - and slams into the reservoir as fast as a formula one car - creating a tsunami 250 metres high which overtops the dam and swamps the valley below - killing more than 2000 people. Seconds from Disaster reveals the systematic errors that led to tragedy - and sheds new light on the landslide mechanism that has baffled scientists for 50 years.

Written by Darlow Smithson Productions

Παρουσίαση των επιπτώσεων και διερεύνηση των αιτίων της αστοχίας. Missed geological feature 250 m below the ground surface.... Moving mountain for the locals...

https://www.youtube.com/watch?v=ybZdLlL4DtY

Seconds from Disaster:
Flood at Stava Dam (Tailings Dam)

Nestle in the beautiful Southern Alps of Italy, lies the Stava valley, the epitome of the unsquared Alpine resort. Then, a terrifying tidal wave of mud surges down the valley at 90 kilometers per hour, destroying everything in its path. 268 people perished in less than 4 minutes. Now, using advanced computer graphics, we reveal exactly what went wrong.

July 19, 1985 / National Geographic 2004

http://www.imdb.com/title/tt0462133/?...

RCEM
Reclamation Consequence Estimating Methodology
Dam Failure and Flood Event
Case History Compilation

Introduction

Dam failure and non-dam related flooding case histories can form the basis of an empirical method of estimating dam failure flood fatalities. The DSO-99-06 was developed in 1999 by Reclamation, and is based on forty such case histories. All of the original case histories presented in DSO-99-06 are contained in this document, plus additional cases. Many of the case histories are located in the United States, but included are notable dam failure or other types of flooding events which occurred in Europe, South America, India, China, Indonesia and Japan.

The estimation of life loss from dam failure is an important part of the risk analysis process which attempts to evaluate a group of dams within a portfolio on equal terms. Potential failure modes (PFM) are developed, and an annual failure probability is estimated for each PFM. Estimated life loss numbers are generated for the PFM and the analysis results are plotted on an f-N chart to evaluate the need for further action and to develop a ranking of the dam's needs relative to other dams in the portfolio.

This document contains a brief summary of every case history that was used to develop DSO-99-06 as well as additional case histories which expand the empirical data set. Relevant and unique information is provided, where available for each case. The purpose of this document is to allow the reader to become familiar with these cases and to possibly create insight into whether a particular case history has similarities to a dam being examined through risk analysis. Each case history description contains a summary table with key parameters, and references are provided if more information is needed. Note that the Reclamation Flood Event Case History Archive, consisting of scanned pdf files of documents used to develop DSO-99-06, contains a great deal of information on many of these case histories.

The estimation of life loss, for a given dam failure, is often based on parameters which are developed through numeric hydraulic analysis. Key parameters are: flood depth multiplied by flood velocity (DV), which can be used to quantify the intensity and destructiveness of flooding; and flood wave travel time, can be combined with other information to estimate warning and evacuation. DSO-99-06 also used a flood severity understanding parameter that is intended to help adjust fatality rates based on how well the downstream public may perceive the risks. While the flood severity understanding is an excellent concept, it is not currently supported with substantial empirical data. RCEM 2014 does not explicitly use the flood severity understanding concept.

DV is an important parameter that is used to help characterize the DSO-99-06 concept of flood severity, which is categorized as being high, medium or low. In descriptive terms, DSO-99-06 provided the following criteria for flood severity classification:

- Low severity occurs when no buildings are washed off their foundations.
- Medium severity occurs when homes are destroyed but trees or mangled homes remain for people to seek refuge in or on.
- High severity occurs when the flood sweeps the area clean and nothing remains. Although rare, this type of flooding occurred below St. Francis Dam and Vajont Dam.

Various research studies have correlated DV with the stability of structures, motor vehicles and people (RESCDAM, Abt, etc.). These studies have helped to form a basis for the numeric definitions of flood severity categories used by Reclamation. DV in relation to building structural stability is considered to be a particularly significant parameter, since the damage or destruction of a house can be considered an indication of potential lethality.

Numerically, flood severity has been described as:

- Low severity where DV is less than 50 ft2 /s
- Medium severity for DV greater than 50 ft2 /s
- High severity for DV greater than 160 ft2 /s combined with rate of rise of at least 10 feet in 5 minutes

Regarding the case histories, several items should be noted:

- There is only one documented case history (South Fork Dam) with instances of high severity flooding where warning is present.
- Fatality rates are based on estimates of PAR which can be very approximate.
- Other information, such as DV and warning time are, in some cases, based on anecdotal information.
- For many of the case histories, varied flood severity may have been present. This may be true for some of the low severity dam failure cases where medium severity flooding may have existed in some areas, typically closer to the dam.
- Some of the low severity flash flood cases only examined fatalities in a particular area of interest, but there may have been additional fatalities occurring within other areas affected by the flood.
- A lot of case histories lack DV information. For these cases, the flood severity classification was based on various methods of DV estimation which are described below. There is a certain amount of subjectivity associated with the flood severity designation for some of these case histories.

Several methods were used to estimate DV for the cases contained in this report. Often there is reported information available for downstream locations concerning maximum depths and flood wave arrival time, which can be converted to a velocity. Many of the DV values were estimated using this data. One should realize though, that this information is often anecdotal, and was often reported by observers who may have been in a state of confusion at the time of observation.

Hydraulic re-creation analysis has been performed for a number of the case histories. For these cases, the estimates of DV are based on modeling results.

Where depth and velocity information was not available, maximum discharge estimations divided by the flood plain width were used to estimate DV at a particular location.

In situations where data is very limited, a range of estimated DV has been based on photos and verbal descriptions of the flood.

Additionally, the location of the PAR may sometimes have been away from locations where the maximum DV had occurred. For some of the case histories, attempts were made to account for this and to reduce the DV estimate.

The case histories do not contain any events which affected large urbanized populations. In this type of situation, evacuation may be restricted by roadway capacity and traffic congestion. For the most part, estimates of fatalities for cases with large, urban populations fall outside the range of existing case history data. The application of empirical data to cases such as this should be approached cautiously. In situations where critical decisions may be affected by the life loss estimate, fatality rates might be better estimated using a numeric model such as the Life Safety Model (LSM).

Note that many of the reference documents used to develop the descriptions of these case history descriptions can be found in what is being referred to as the "Reclamation Flood Event Case History Archive". The archive is a collection of reports, papers, newspaper articles and other information that was compiled by Reclamation employee Wayne Graham before his retirement. Another significant contributor to the archive was Reclamation employee Earl (Bud) Bay, also now retired.

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https://www.usbr.gov/ssle/damsafety/documents/RCEM-CaseHistories20140304.pdf

☙ ❧

DAMS FAILURE IN EUROPE

MSc. Graduate: TIANJI LI, October 2015

Abstract

In the European continent, as everywhere in the world, dam building has been very common for centuries and millenniums. It used to be small dams built with basic means. With industrial revolution, development of fluvial transport and agricultural improvements, needs became more and more important. In this document, I have collected the available information about European dams and their main failures, depending on their typology, and I have introduced the present data-based models for the prediction of dam behaviour.

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https://www.politesi.polimi.it/bitstream/10589/112901/3/Tianji_Tesina.pdf

ΔΙΑΚΡΙΣΕΙΣ ΕΛΛΗΝΩΝ ΓΕΩΜΗΧΑΝΙΚΩΝ

Βράβευση του Αντώνη Ζερβού με το 2017 BGA Medal

2017 BGA Medal is awarded to a paper on 'A Behavioural Framework for Fibre-reinforced Gravel' published in Géotechnique by authors Ajayi, Le Pen, Zervos and Powrie

The British Geotechnical Association (BGA) is pleased to announce that the 2017 BGA Medal has been awarded to a paper on '**A Behavioural Framework for Fibre-reinforced Gravel**' published in *Géotechnique* by authors Dr Olufemi Ajayi (now with Ramboll, formerly at University of Southampton) Dr Louis Le Pen, Dr Antonis Zervos and Professor William Powrie (all of University of Southampton). The medal will be presented during the BGA Annual Conference on 19 June 2018.

The full reference for the paper is:

Ajayi, O, Le Pen, L, Zervos, A and Powrie, W (2017). A behavioural framework for fibre-reinforced gravel. *Géotechnique* 67, No. 1, 56–68.

The paper discusses how random fibre reinforcement of railway ballast can improve strength and ductility, and reduce the susceptibility of ballast to the ongoing settlement that necessitates periodic maintenance interventions. Based on a series of triaxial tests on scaled materials, the paper develops a behavioural framework that accounts for the additional effective confining stress in the granular matrix resulting from the fibre tensions. It has been used to specify field trials now in progress on London Underground. The work was supported financially by the Engineering and Physical Sciences Research Council and Network Rail.

The BGA Medal is awarded annually (each calendar year) by the BGA to a paper substantially authored by a BGA member or BGA members published in an international journal and from BGA, ISSMGE and ISRM conferences, and submitted for consideration of the award.

Dr Antonis Zervos CivEng/NTUA PhD/NTUA FHEA

Dr Antonis Zervos is Associate Professor in Geomechanics within Engineering and the Environment at the University of Southampton and Deputy Head of the Infrastructure Research Group.

Antonis Zervos graduated in 1996 from the Faculty of Civil Engineering, National Technical University of Athens, with a 5-year degree in Civil Engineering. In the same year he joined the Doctoral Programme of NTUA's Department of Mechanics, from where he obtained a PhD in 2001. His research was sponsored by Schlumberger Cambridge Research through a research assistantship at their Cambridge facilities between 1996 and 2001. After obtaining his PhD he worked as a consultant before joining the University of Southampton in 2002.

He has served as Editorial Board member for Géotechnique (2009-2012) and Geomechanics for Energy and the Environment (2014-2017), as Vice-chair of UK's Association for Computational Mechanics - UK-ACM, at the time called ACME (2009-2010), and as external evaluator on behalf of the Romanian National Research Council and the Hellenic Quality Assurance and Accreditation Agency.

He is a member of the UK-ACM Executive Board, the Board of Directors of the ALERT/Geomaterials European network of geomechanics experts, and the EPSRC Peer Review College. He also serves as external evaluator for the European Commission's Research Executive Agency.

In 2017 he was a co-recipient of ICE's Baker Medal for a paper titled "Thermo-poro-mechanical analysis of landslides: from creeping behaviour to catastrophic failure", published in Geotechnique (DOI: 10.1680/jgeot.15.LM.006).

Research interests

Antonis Zervos's technical area of expertise is the constitutive and numerical modelling of geomaterials; his work is focussed on understanding, describing mathematically and approximating numerically the mechanical behaviour of soils and rocks. He is an experienced numerical modeller with significant expertise in programming and using finite element and finite difference codes, as well as using boundary element and distinct element software

He has an active interest in the following applications:

- The mechanics of railway ballast and ballasted track.
- The mechanics of catastrophic landslides.
- The mechanics of oceanic sediments bearing gas-hydrates.
- Modelling the effects of material microstructure.

Finally, geomaterial modelling is an integral part of tackling problems relevant to the production of oil and natural gas. Mostly during his time at Schlumberger Cambridge Research, Antonis Zervos carried out research and consultancy on petroleum geomechanics, and particularly on hydraulic fracturing, on the stability of inclined wellbores and perforations, on wellbore-screen interaction, and on stress determination around large geological structures.

https://www.southampton.ac.uk/engineering/about/staff/az.page

Tel. (023) 8059 2459

Email: A.Zervos@soton.ac.uk

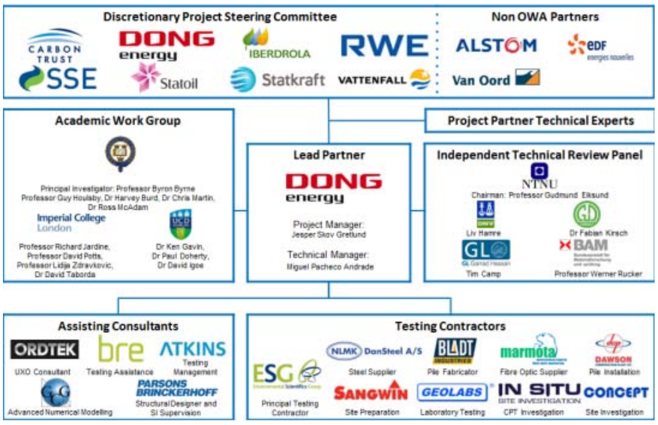
ΠΑΝΕΠΙΣΤΗΜΙΑΚΕΣ ΘΕΣΕΙΣ ΚΑΙ ΜΕΤΑΠΤΥΧΙΑΚΕΣ ΣΠΟΥΔΕΣ

[illegible]
University of Oxford

Η [illegible] Ørsted [illegible] Πανεπιστήμιο της Οξφόρδης [illegible]

https://orsted.com/en/Media/Newsroom/News/2018/02/Orsted-and-University-of-Oxford-sign-five-year-agreement-to-optimise-wind-turbine-foundations

Η συμφωνία έρχεται σε συνέχεια του ερευνητικού προγράμματος PISA, [illegible] ν τομέα ανάπτυξης υπεράκτιων ανεμογεννητριών - Ibedrola, ETA, Statoil, κλπ υπό την τεχνική καθοδήγηση της Ørsted (πρώην Dong Energy). Το έργο διοργανώθηκε από το Πανεπιστήμιο της Οξφόρδης [illegible] Imperial College του Λονδίνου [illegible] University College του Δουβλίνου [illegible].



[illegible] 3 [illegible] (PhD), [illegible] Ørsted, [illegible] Πανεπιστήμιο της Οξφόρδης [illegible] Οκτώβριο 2018.
Οι υποψήφιοι διδάκτορες θα εργαστούν στο ερευνητικό πρόγραμμα, υπό την [illegible] του Πανεπιστημίου της Οξφόρδης [illegible] Ørsted.

Πιστεύω ότι αποτελεί μια εξαιρετική ευκαιρία για νέους μηχανικούς που θέλουν να πραγματοποιήσουν διδακτορική διατριβή σε ένα πολύ ενδιαφέρων τομέα της γεωτεχνικής μηχανικής.

[illegible] link - http://www.eng.ox.ac.uk/study-here/postgraduate/studentships/orsted-research-studentships-in-geotechnical-design-for-offshore-wind-turbines

[illegible]

Best regards,
Yiorgos Perikleous
Senior Geotechnical Engineer
Geotechnical Design & Installation
Wind Power

Learn more at orsted.co.uk

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2820 Gentofte
Denmark
Tel. +45 99 55 10 96

geope@orsted.dk
orsted.co.uk

Danish Technical University
Department of Civil Engineering

Από την [illegible] ΕΕΕΕΓΜ [illegible] Ζανία [illegible]:

http://www.geotechnics.byg.dtu.dk/research/jobliste/job?id=93af7c7d-d839-4ea5-b6c6-f4879806129c

I would be grateful if you could forward this announcement to any good eligible candidate, who would be interested in working with us at DTU.

Kind regards,

Varvara Zania
Associate Professor
DTU Civil Engineering

Technical University of Denmark
Department of Civil Engineering
Nordvej
Building 119, Room 163
2800 Kgs. Lyngby
Direct +45 45255092
vaza@byg.dtu.dk
http://www.geotechnics.byg.dtu.dk/

Assistant or Associate Professor in Rock Mechanics

The Department of Civil Engineering (DTU Byg) invites applications for an Assistant/Associate Professor position in the Section for Geotechnics and Geology.

DTU Civil Engineering is composed of six sections with the Section for Geotechnics and Geology focusing on geotechnical engineering and geology including infrastructure design and development of geological energy resources and raw materials.

We seek an established researcher within the broad field of rock mechanics having a proven publication record and experience in collaboration with the industry.

The assistant or associate professorship is a permanent entry-level faculty position.

Research will be performed in the field of rock mechanics. Ongoing projects address rock mechanics of chalk and clay-rich chalk in the subsurface of Denmark and the North Sea, with a focus on experimental and theoretical work. Development of numerical models suitable for these soft rocks is anticipated.

The section for Geotechnics and Geology is engaged in research for infrastructure projects in Denmark, so upcoming projects can address various topics of engineering design in rocks such as foundation, deep excavation and tunnelling.

Responsibilities and tasks

The Department is looking for a flexible and enthusiastic candidate, who will take part in developing a rock mechanics research platform for collaboration with civil- and petroleum engineers, geologists and geophysicists. In particular it is expected that the successful candidate will be able to contribute to one or more of the following fields:

- Teaching rock mechanics at basic and advanced level.
- Rock mechanics and fracture analysis.
- Coupled processes and multiscale poromechanics and flow
- Experimental rock mechanics
- Constitutive modelling of rock formations
- Infrastructure design and analysis in rock formations
- Reservoir rock mechanics

Dissemination of research results is expected through scientific publications, interdisciplinary collaborative projects at national and international level, and services to public administrations and the industry.

Furthermore, the candidate is expected to seek and achieve external funding.

Educational responsibilities include among other things classroom teaching/lecturing, supervision of individual or group projects, and supervision of M.Sc. students, Ph.D. students, and postdocs. The educational responsibilities will to the extent possible be related to the research focus area, however flexibility is required and it is expected that the candidate will be able to cover and contribute to a wide spectrum of topics within basic geotechnics on both bachelor and master level.

Please note that the expected teaching on undergraduate level is primarily to be in Danish and on postgraduate level (M.Sc. or PhD) it is required to be in English. For international candidates, DTU offers Danish language courses for the purpose of being able to teach in Danish within the first 2-3 years.

Administrative duties include academic assessment work on all levels.

The candidate is expected to operate within an interdisciplinary research team as well as actively collaborate with other research groups at DTU, e.g. environmental engineering, structural engineering, arctic engineering, or building energy.

THURSDAY 14 JUN 18

Apply for this job

Apply no later than 10 August 2018
Apply for the job at DTU Civil Eng by completing the following form.

Apply online

ΠΡΟΣΦΟΡΑ ΕΡΓΑΣΙΑΣ

ice recruit

Move to New Zealand. Why wouldn't you?

More than 20 geotechnical civil engineering professionals required (experience requirements range from 4 - 20+ year)

When you move to a country with a more stable economy, providing opportunities to get involved in career defining projects, whilst in the process of offering a better lifestyle, better climate, sensational beaches, awesome ski slopes, and simply more access to whatever you want to do in your spare time - why wouldn't you?

Due to New Zealand's massive programme of infrastructure projects planned over the next 10 years, positions are now available country wide for experienced tertiary qualified civil engineers specialised in geotechnical engineering. We are seeking geotechnical experts with advanced design skills (previous seismic experience ideal) complemented by exceptional project management and business development skills to work in a variety of roles varying from intermediate to senior level engineers, technical specialists, and in senior management capacities (salaries range from £30k - £55k for experience levels from 8 to 20 plus years).

You will work on a variety of technically challenging residential, commercial and infrastructure projects in which your well-honed skills to solve geotechnical engineering problems will be put to good use. To top it all you get to live in an awesome country whose main city is ranked 3rd best quality of life in the world with the other New Zealand cities arguably better and cheaper. If you have 4 plus years expertise in the field of geotechnical engineering projects in a range of soil and rock types for highways, mining, industrial and government clients, you may well be of considerable interest to our clients.

The roles are positioned across the major cities in New Zealand: Auckland, Wellington, Christchurch, Hamilton, Tauranga and Dunedin. Please email your CV to Andy Hopkins at ahopkins@catalystrecruitment.co.nz. Alternatively feel free to call on +6749 307 6112

About Catalyst Recruitment

Catalyst are a New Zealand-based international sourcing specialist. We provide a seamless service if you want to move to and work in Australia or New Zealand. We actually call you and speak with you! Due to our extensive experience (including personal experience – we're Brits ourselves), we can take you through the entire process from your first enquiry to your arrival in Australia or New Zealand.

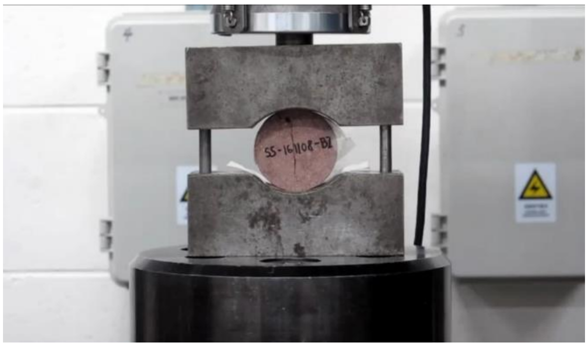
ΝΕΑ ΑΠΟ ΤΙΣ ΕΛΛΗΝΙΚΕΣ ΚΑΙ ΔΙΕΘΝΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΝΩΣΕΙΣ

New videos of ISRM Suggested Methods on the ISRM website

Based on the cooperation between Prof. Seokwon Jeon from Seoul National University (South Korea) and the ISRM Commissions on Testing Methods and on Education, video films on the ISRM Suggested Methods, which are made for educational purposes, have been embedded on the ISRM website.

Recently, two new videos have been included:

- Uniaxial compressive strength and deformability of rock materials (updated version)
- Brazilian tension test



More educational videos are being prepared and will be uploaded soon at the [Suggested Methods videos page](#).

ΠΡΟΣΕΧΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΚΔΗΛΩΣΕΙΣ

Για τις παλαιότερες καταχωρήσεις περισσότερες πληροφορίες μπορούν να αναζητηθούν στα προηγούμενα τεύχη του «περιοδικού» και στις παρατιθέμενες ιστοσελίδες.

ICOLD 2018 26th Congress – 86th Annual Meeting, 1 - 7 July 2018, Vienna, Austria, www.icoldaustria2018.com

Geotechnical Construction of Civil Engineering & Transport Structures of the Asian-Pacific Region, 4 ÷ 7 July, 2018, http://gccets.com

9th International Conference on Physical Modelling in Geotechnics (ICPMG 2018), 17-20 July 2018, London, UK, www.icpmg2018.london

ICSSTT 2018 - 20th International Conference on Soil Stabilization Techniques and Technologies, July 19 - 20, 2018, Toronto, Canada, https://waset.org/conference/2018/07/toronto/ICSSTT

GeoChine 2018 - 5th GeoChina International Conference Civil Infrastructures Confronting Severe Weathers and Climate Changes: From Failure to Sustainability, July 23-25, HangZhou, China, http://geochina2018.geoconf.org

☙ ❧

UNSAT2018 The 7th International Conference on Unsaturated Soils, 3 - 5 August 2018, Hong Kong, China, www.unsat2018.org

China- Europe Conference on Geotechnical Engineering, 13-16 August 2018, Vienna, Austria, https://china-euro-geo.com

☙ ❧

International Symposium on Seismic Performance and Design of Slopes
18 ÷ 19-08-2018, Shanghai, P.R. China
http://geotec.tongji.edu.cn/show.aspx?info_lb=328&flag=190&info_id=1424

Introduction

Earthquake-induced landslides were always numerous, widespread, and catastrophic. For the seismic design method of slope, it has developed from empirical design, specification design based on pseudo-static method, into performance based design. However, there are still many challenges in the seismic design of slope, such as uncertainties in the seismic design, dynamic behaviors of soil and slopes subjected to earthquake, improvement and innovation of seismic design method, etc.

In order to prevent and mitigate the landslide disaster triggered by earthquake, the First International Symposium on Seismic Performance and Design of Slopes aims to bring together academic scientists, leading engineers, and students to exchange and share their experiences and research results.

Themes

- Uncertainty sources of seismic design of slopes
- Dynamic behaviors of slope subjected to earthquake
- Performance-based seismic design method of slopes
- Prospect to the seismic design of slopes in future
- Practice of seismic design in major slope projects

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Website: http://geotec.tongji.edu.cn/show.aspx?info_lb=328&flag=190&info_id=1424

☙ ❧

CRETE 2018 6th International Conference on Industrial & Hazardous Waste Management, 4-7 September 2018, Chania, Crete, Greece, www.hwm-conferences.tuc.gr

☙ ❧

Hydropower Development 2018
5 - 6 September 2018, Zurich, Switzerland
www.wplgroup.com/aci/event/hydropower-development-europe

Already on its 5th edition, ACI's Hydropower Development 2018 will bring together senior executives and experts from the hydropower industry, policy makers, consultants, technology innovators, engineers, investors, project developers and leading market analysts to discuss the latest challenges and developments within the industry.

The two day event will give you an insight to the industry`s latest policy evaluations and, while focusing largely on hydro power production & development in Europe, will also concentrate on updates and future forecasts on future environmental & energy trends and its impact on both, Hydro power operations & market dynamics.

Hydropower Development 2018 will focus on in depth insights into the latest policy & legislation regulations, key market applications and overviews, the place of hydropower within larger context of the renewable energy arena & its relationship with the climate change dynamics. Very important aspect for this year will also be the newest technology advancements, particularly the digitalisation of hydropower plants. The 2 Day event will start with an extensive analysis of current & future European policy objectives, particularly the Water Framework Directive, 2017 & evaluations of Natura 2000 guidance. The event will provide an in depth outlook into the key European markets, focusing largely on environmental objectives, hydropower operations, machinery maintenance and new built projects, production flexibility & technology innovations. The participants will have a chance to take an active part in our interactive meeting to share their knowledge, experience and uncertainties. While providing a holistic outlook into the future of hydro power development in Europe, the event will focus on specific operational, technological & maintenance solutions which will allow hydro power industry to stay competitive in the renewable energy mix as a whole.

Key Topics

- Analysing Hydropower In The Legal Context: Environmental & Engineering Challenges
- Staying Competitive In Ever Changing Market Trends: Analysing Different National Experiences
- Expanding Hydropower Storage Solutions & Operations Flexibility
- Increasing Asset Optimisation & Asset Efficiency In Hydropower Operations
- Hydropower In The Environmental Context
- Hydropower Sustainability & The Future Of Renewable Energy Strategy
- Exploring Key Business Opportunities & Technology Innovations
- Hydropower`s Economy & Investment Strategy

EUCEET 2018 - 4th International Conference on Civil Engineering Education: Challenges for the Third Millennium, 5-8 September 2018, Barcelona, Spain, http://congress.cimne.com/EUCEET2018/frontal/default.asp

SAHC 2018 11th International Conference on Structural Analysis of Historical Constructions "An interdisciplinary approach", 11-13 September 2018, Cusco, Perú http://sahc2018.com

26th European Young Geotechnical Engineers Conference, 11 - 14 September 2018, Reinischkogel, Austria, www.tugraz.at/en/institutes/ibg/events/eygec

11th International Conference on Geosynthetics (11ICG), 16 - 20 Sep 2018, Seoul, South Korea, www.11icg-seoul.org

CHALK 2018 Engineering in Chalk 2018, 17-18 September 2018, London, U.K., www.chalk2018.org

International Conference on Geotechnical Engineering and Architecture URBAN PLANNING BELOW THE GROUND LEVEL: ARCHITECTURE AND GEOTECHNICS, 19-21 September 2018, Saint Petersburg, Russia, http://tc207ssi.org

International Symposium on Energy Geotechnics SEG - 2018, 25-28 September 2018, Lausanne, Switzerland https://seg2018.epfl.ch

TMM 10 1 CH 1 0 8

1st International Conference TMM_CH
Transdisciplinary Multispectral Modelling and Cooperation for the Preservation of Cultural Heritage
10-13 October, Athens, Greece
www.tmm-ch2018.com

Innovative scientific methodologies and challenging projects marking future trends in the protection of cultural heritage, have initiated a universal conversation within a holistic approach, merging capabilities and know-how from the scientific fields of architecture, civil engineering, surveying engineering, materials science and engineering, information technology and archaeology, as well as heritage professionals on restoration and conservation and policy makers in cultural heritage. The combined utilization of digital documentation technologies with innovative analytical and non-destructive techniques, computational and digital techniques and archaeometric methods supports the creation of a transdisciplinary multispectral modelling towards the sustainable preservation of cultural heritage. Innovation is enhancing and revealing a critical dimension of the preservation of cultural heritage along with social participation and communication.

The National Technical University of Athens interdisciplinary team "Protection of monuments" [Prof. A. Moropoulou, Prof. Emer. M. Korres, Prof. A. Georgopoulos, Prof. C. Spyrakos, Ass. Prof. C. Mouzakis], scientific responsible for the Holy Aedicule's rehabilitation of the Holy Sepulchre in Jerusalem, and the Technical Chamber of Greece, in cooperation with the Ministry of Culture and Sports and the Ministry of Digital Policy, Telecommunications and Media of the Hellenic Republic, organize the **1st International Conference on "TRANSDISCIPLINARY MULTISPECTRAL MODELLING AND COOPERATION FOR THE PRESERVATION OF CULTURAL HERITAGE" [TMM_CH]** on 10-13 October 2018, in Athens, Greece, discussing modern trends in the original agora of our technological and democratic roots.

TMM_CH international conference is organized under the auspices of H.E. the President of the Hellenic Republic, with the support of the Hellenic Parliament, in cooperation with the National Geographic Society, World Monuments Fund, ICOMOS, European Construction Technology Platform, European Society for Engineering Education, and other major international and European organizations, associations and networks in the field of cultural heritage preservation.

The conference will be held at the Eugenides Foundation, with reference to the Digital Exhibition of Advanced Technology "Tomb of Christ: the Monument and the Project" at the Byzantine and Christian Museum of Athens [21 May 2018 until 31 January 2019]. Scientific walk and talk visits to Acropolis and Ancient Agora [in the footsteps of the Greek Peripatetic Philosophical School] and other major archaeological sites are planned on 13 October 2018.

The International Steering Committee and the International Scientific Committee welcome research contributions for oral and poster presentations in English. The submitted abstracts and papers will be peer reviewed. Accepted papers will be divided into sessions. Plenary lectures [after invitation] will cover major accomplishments, trends and technical challenges. Please check important dates for submission deadlines.

Selected papers will be published in a special edition of Springer LNBIP series [available in 2018 following the Conference] as well as to selected international Scientific Journals.

TOPICS

- Cultural heritage identity
- Cultural heritage revealing of values and historic representation
- Cultural heritage management towards sustainable development (tourism et al)
- Education and training for the preservation of cultural heritage
- History of architecture, historic materials and structures of cultural heritage
- Geometric documentation
- Digital, augmented (AR) and virtual (VR) documentation of cultural heritage
- 3D reconstruction of cultural heritage
- Interdisciplinary risk assessment and preservation of cultural heritage: design, materials and interventions / documentation, diagnosis, conservation, preservation, rehabilitation, reconstruction, restoration
- In situ advanced diagnostics and inspection by non-destructive techniques, robotics and unmanned aerial vehicles
- Laboratory testing and methods for characterization and validation of historic materials and structures
- Compatible and performing, repair and strengthening materials and techniques
- Criteria, methodologies and techniques to assess sustainable and compatible materials and interventions techniques
- Numerical modeling and structural analysis
- Seismic analysis and retrofit
- Standards, metadata, ontologies and semantic processing in cultural heritage
- Tools for multidimensional and multidisciplinary modeling
- Monitoring of monuments' response to environmental stresses and of structural health
- Enhancing resilience of cultural heritage against climate change and natural hazards
- Interdisciplinary knowledge based decision making
- Management of cultural heritage preservation projects and strategies
- Interdisciplinary projects and methodologies
- Historic architectural sites and preserved monuments as open labs of innovation and sustainable socioeconomic development
- Transdisciplinary cooperation and innovation for the preservation of cultural heritage
- Stakeholders' requirements for cultural heritage preservation
- Socio-economic and cultural impact of cultural heritage preservation
- Historic cities and centers: new strategies for protection by development and reuse
- Circular economy and innovative strategies for sustainable preservation of cultural heritage
- From research and innovation to policy for cultural heritage preservation
- Education and training for the preservation of cultural heritage
- Cultural heritage preservation with social accessibility and engagement

CS ZO

HYDRO 2018 - Progress through Partnerships, 15-17 October 2018, Gdansk, Poland, www.hydropower-dams.com/hydro-2018.php?c_id=88

GEC - Global Engineering Congress Turning Knowledge into Action, 22 - 26 October 2018, London, United Kingdom, www.ice.org.uk/events/global-engineering-congress

ISEV 2018 CHANGSHA The 8th International Symposium on Environmental Vibration and Transportation Geodynamics & the 2nd Young Transportation Geotechnics Engineers Meeting, October 26–28, 2018, Changsha, China, www.isev2018.cn

8th International Congress on Environmental Geotechnics "Towards a Sustainable Geoenvironment", 28 October to 01 November 2018, Hangzhou, China, www.iceg2018.org

ARMS10 - 10th Asian Rock Mechanics Symposium, ISRM Regional Symposium, 29 October - 3 November 2018, Singapore, www.arms10.org

UNSAT Oran 2018 4ème Colloque International Sols Non Saturés & Construction Durable, 30-31 October 2018, Oran, Algeria, www.unsat-dz.org

Energy and Geotechnics The First Vietnam Symposium on Advances in Offshore Engineering, 1-3 November 2018, Hanoi, Vietnam, https://vsoe2018.sciencesconf.org

ACUUS 2018 16th World Conference of Associated Research Centers for the Urban Underground Space "Integrated Underground Solutions for Compact Metropolitan Cities", 5 – 7 November 2018, Hong Kong, China, www.acuus2018.hk

CS ZO

ISRBT2018

International Seminar on Roads, Bridges and Tunnels
Challenges and Innovation
9-15 November 2018, Thessaloniki, Greece
http://isrbt.civil.auth.gr

SEMINAR SCOPE AND LAYOUT

The School of Civil Engineering of the Aristotle University of Thessaloniki will organize an International Educational Seminar on Roads, Bridges and Tunnels, the ISRBT2018, in Salonica, in November 2018. This will be the 3rd Seminar of the kind, after the ISRBT2016, and ISRBT2017, gathering 120 participants and 30 invited speakers from 10 European countries. The 3rd International Seminar on Roads, Bridges and Tunnels, fully renovated, will address practical aspects of design, construction and management, aiming, especially, to enlighten the applied part of the engineering know-how, useful to professionals of international prospects. The 3rd ISRBT will consist of three 2-day Sessions, 9-10 November Bridges, 12-13 November Roads and Motorways, 14-15 November Geotechnics and Tunnels.

THE ISRBT2018 SEMINAR TOPICS

ISRBT Topics/Lectures will address the following subjects:

- Construction management of motorway projects
- Motorway concession projects
- Motorway construction projects in international context
- Road earthworks and environment

- Landslides and stabilization measures
- Construction methods for bridges
- Suspended bridges
- Motorway operations
- NATM tunnelling method for motorways
- Metro Tunnelling
- Traffic safety and ITS Systems on motorways
- Interchanges

THE SEMINAR IS ADDRESSED TO:

Construction Engineers and Designers, Motorway Operators and Contractors, Geotechnical and Bridge Engineers.

LINKS TO EMPLOYMENT

The 3rd ISRBT aims to establish real links between young engineers and companies active in the field of services, construction products, entrepreneurship and innovation in engineering.

CONTACT

For any further information please visit our website: http://isrbt.civil.auth.gr or contact us by email at isrbt@civil.auth.gr

Secretariat: Mrs. D. Gatoula, tel. +30 2310 994385

International Symposium Rock Slope Stability 2018, 13-15 November, 2018, Chambéty, France, www.c2rop.fr/symposium-rss-2018

GeoMEast 2018 International Congress and Exhibition: Sustainable Civil Infrastructures, 24 - 28 November 2018, Cairo, Egypt, www.geomeast.org

The Fourth Australasian
Ground Control in Mining Conference
28–30 November 2018, Sydney, Australia
http://ausrock.ausimm.com

The conference will provide an update to all mining industry geotechnical personnel on best practice in both Australasia and overseas.

AusRock 2018 provides a vehicle for information exchange between the **coal and metalliferous sectors** of the industry with a focus on new technologies and developments, industry needs and mine site problem solving, and practical case studies.

AusRock 2018 is an ISRM Specialised Conference.

Conference themes

- Ground support – tendon systems, surface liners, injection systems in open cut and underground mining
- Alternative materials in ground control
- Geotechnical instrumentation, monitoring and data management
- Mine design – geotechnical considerations
- Geotechnical design methodologies
- Geomechanics of multiseam, multireef and complex orebodies
- Geotechnical challenges in extreme mining environments
- Backfill technologies
- Pillar design and performance
- Rock mass characterisation techniques and practice
- Regional stability
- Slope stability
- Geotechnical risk management
- Best practice case studies
- New challenges and innovations in ground control
- Numerical modelling in design
- Mine subsidence – prediction and control
- Caving mechanics and control
- Dynamic mining events and managing large deformations
- Geotechnical education and training

Contact Us

The Australasian Institute of Mining and Metallurgy
Ground Floor
204 Lygon Street
Carlton South
Victoria 3053 Australia
Telephone: +61 3 9658 6100

Second JTC1 Workshop on Triggering and Propagation of Rapid Flow-Like Landslides
03-05 December 2018, Hong Kong

Organiser: Joint Technical Committee on Natural Slopes and Landslides (JTC1)

Co-organiser: The Hong Kong Geotechnical Society; The Geotechnical Division of the Hong Kong Institution of Engineers; The Hong Kong University of Science and Technology

Contact person:

Professor Clarence Choi
Hong Kong University of Science and Technology, Clear Way Bay, Kowloon
Email: ceclarence@ust.hk

13th Australia New Zealand Conference on Geomechanics 2019
01 ÷ 03-04-2019, Perth, Australia
http://geomechanics2019.com.au

On behalf of the Australian Geomechanics Society, the New Zealand Geotechnical Society and the Conference Organising Committee it is my pleasure to invite you to the **13th Australia New Zealand Conference on Geomechanics in 2019** in Perth, Western Australia.

The conference will be held at the Perth Convention and Exhibition Centre situated in the heart of Perth in Western Australia. The conference has a diverse range of themes including: Foundations and Retaining Structure, Ground Improvement, Offshore and Nearshore Geotechnics plus many more.

This promises to be an ideal forum for exploring the recent learnings in the broader Geomechanics community. It is from these learnings that the industry is able to continue to drive new innovations and drive practice forward.

The Australia New Zealand Conference on Geomechanics is always an important meeting place for professionals working in the Geomechanics industry and will again be a great place to explore the new directions emerging in the industry. It is an opportunity to engage with speakers from across Australia, meet up with colleagues, network and visit the exhibitor displays.

Conference Managers

Arinex Pty Ltd
ABN.28 000 386 676
3/110 Mounts Bay Road
Perth, Western Australia 6000
Tel: 08 9486 2000
Fax: 08 9267 5443
ANZgeomechanics2019@arinex.com.au

Water Storage and Hydropower Development for Africa
2-4 April 2019, Windhoek, Namibia
www.hydropower-dams.com/pdfs/africa19.pdf

AFRICA 2019 will be the third international conference focusing on water storage and renewable energy development in Africa, co-hosted by Aqua~Media International and the International Commission on Large Dams.

Conference Themes

Planning and development

- Review of plans and progress in Southern Africa
- Plans and current schemes throughout the continent
- Small hydro projects and rural electrification
- Powerpools and cross-border opportunities
- The value of integrated regional development
- Project preparation; making projects bankable
- Tools for project assessment and design
- Appropriate project planning and benefit sharing
- Grid operation: national and integrated regional systems

Hydrology and flood and drought management

- Hydrology: drought mitigation and management
- Implications of climate change
- Water infrastructure and flood discharge works (innovation, efficiency, safety and economy)
- Sedimentation: planning and design approaches
- Innovative spillway design

Civil works and challenging conditions

- Site planning for safety and efficiency
- Construction management
- Materials for dams: past experience and future developments
- Selecting appropriate construction equipment
- Seismic design and tackling complex geology
- Innovative solutions in design and construction

Hydro technology

- Appropriate low cost solutions for remote communities
- Site planning: economy and efficiency in equipment selection; workforce training; health and safety aspects
- Technology: towards safe and economic schemes
- Hydro machinery for challenging conditions
- Maintenance and timely refurbishment
- Hydro in synergy with other renewable energy sources
- Optimizing operation of powerplants
- Pumped storage: technology, role in the grid and benefits

Environmental and social aspects

- Impact assessment: methodology and experience
- Mitigation measures for downstream environmental and social impacts
- Facilitating communications with project affected people
- Capacity building and training for best practice

Finance, economics and commercial aspects

- Securing project finance for water and energy infrastructure
- Chinese funding and investment opportunities
- Legal and contractual issues
- Carbon credits, carbon trading and income diversification

Safety

- Approaches to complex geology and design for seismic areas
- Learning from international accidents and failures
- Upgrading civil works and powerplants to enhance safety
- Health and safety of the workforce on site

In addition to plenary and parallel sessions exploring the themes above, there will be workshops, panel discussions and training workshops, including some pre-Conference side events.

Contact

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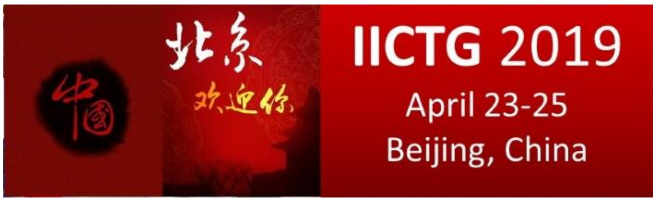

2nd International Intelligent Construction Technologies Group Conference
"Innovate for Growth, Collaborate for Win-Win"
23-04-2019 - 25-04-2019, Beijing, China
www.iictg.org/2019-conference

The second IICTG conference will be held in Beijing, China from April 23 to 25, 2019.

The goal of this conference is to optimize the resources from relevant fields and to facilitate communication among ICT experts and professionals for further innovation, development, and mutual benefits.

IICTG encourages you to share the latest-&-pertinent topics in presentation form on the following topics:

- Framework and Contents for Intelligent Infrastructure Construction
- Intelligent Compaction Theory and Engineering Application
- Research and Development for Mechanical and Compacted Materials (soils, base, and asphalt) Interaction Models
- Intelligent Construction Equipment and Infrastructure Construction QC
- Development Trend for Compaction Equipment
- Intelligent Testing Techniques for Infrastructure
- Artificial Intelligence and Intelligent Construction
- Application of Building Information Modeling (BIM) in roadway subbase, roadway surface, airport pavements, and dam construction
- Information Technologies for Infrastructure Construction and Intelligent Data Management
- Impact of Intelligent Construction Demand on Innovation and Upgrades of Construction Technologies and Equipment
- Other Aspects of Infrastructure Construction

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Website: http://www.iictg.org/2019-conference

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WTC2019 Tunnels and Underground Cities: Engineering and Innovation meet Archaeology, Architecture and Art and ITA - AITES General Assembly and World Tunnel Congress, 3-9 May 2019, Naples, Italy, www.wtc2019.com

2019 Rock Dynamics Summit in Okinawa, 7-11 May 2019, Okinawa, Japan, www.2019rds.org

Underground Construction Prague 2019, June 3–5, 2019, Prague, Czech Republic, www.ucprague.com

VII ICEGE ROMA 2019 - International Conference on Earthquake Geotechnical Engineering, 17 - 20 June 2019, Rome, Italy, www.7icege.com

ICONHIC2019 - 2nd International Conference on Natural Hazards and Infrastructure, 23-26 June 2019, Chania, Crete Island, Greece, https://iconhic.com/2019/conference

IS-GLASGOW 2019 - 7th International Symposium on Deformation Characteristics of Geomaterials, 26 - 28 June 2019, Glasgow, Scotland, UK, https://is-glasgow2019.org.uk

cmn 2019 -Congress on Numerical Methods in Engineering, July 1 - 3, 2019, Guimarães, Portugal, www.cmn2019.pt

The 17th European Conference on Soil Mechanics and Geotechnical Engineering, 1st - 6th September 2019, Reykjavik Iceland, www.ecsmge-2019.com

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3rd International Conference
"Challenges in Geotechnical Engineering" CGE-2019
10-09-2019 - 13-09-2019, Zielona Gora, Poland
www.cgeconf.com

University of Zielona Gora (Poland) and Kyiv National University of Construction and Architecture (Ukraine) under the Patronage of Polish Committee on Geotechnics takes a great pleasure to invite participants to the Third International Conference "Challenges in Geotechnical Engineering" CGE-2019, which will take place in Zielona Gora (Poland), 10-13 September 2019..

The conference program includes the following topics:

- Laboratory and in-situ tests
- Theoretical and analytical solutions in geomechanics
- Numerical formulations of geotechnical problems
- Geotechnical practice and case study
- Transportation geotechnics
- Geological and glacitectonic problems
- Special session "Pile tests - 2019"

A special conference session "Pile tests - 2019" is devoted to pile foundation - soil interaction. Organisers invite participants to a competition to predict the behaviour of a soil - pile foundation system under static vertical load. The submitted solutions will be compared against results obtained in an in-situ real-scale test and in a laboratory small-scale test conducted before the Conference. The soil investigation results, the geometry of the problem and the loads will be available on the conference web page.

Contact person: Co-Chairmen of the Organising Committee: Volodymyr Sakharov, Waldemar Szajna
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Fax: +48 (68) 328 47 23
Email: info@cgeconf.com
Website: http://www.cgeconf.com

cs ꟈ

14th ISRM International Congress, 13-18 September 2019, Iguassu Falls, Brazil, www.isrm2019.com

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3rd ICITG

3rd International Conference on Information Technology in Geo-Engineering
Sep. 29-02 Oct., 2019, Guimarães, Portugal
www.3rd-icitg2019.civil.uminho.pt

The 3rd International Conference on Information Technology in Geo-Engineering (3rd ICITG) is organised in the framework of the activities of the Joint Technical Committee 2 (JTC2) on Representation of Geo-Engineering Data of the Federation of International Geo-Engineering Societies (FedIGS). FedIGS, is an umbrella organization linking international professional societies in the field of "Geo-Engineering": ISSMGE International Society for Soil Mechanics and Geotechnical Engineering, ISRM International Society for Rock Mechanics and Rock Engineering, IAEG International Association for Engineering Geology and the Environment, IGS International Geosynthetics Society.

This conference aims to address the most updated developments in information communication and technologies in geo-engineering. It covers the application to laboratory and field tests, as well as the monitoring and survey of geo-structures. It embraces also intelligent geomaterials, intelligent construction and all the related aspects with design, construction and maintenance of geo-structures.

The main themes of the conference include:

1. Data exchange (including ownership/legal aspects)
2. Use of Information and communications technologies (ICT) in laboratory and field works
3. Big data and databases
4. Data mining and data science
5. Imaging technologies
6. Building information modeling (BIM) applied to geo-structures
7. Artificial intelligence
8. Intelligent constructions
9. Optimization systems
10. Virtual reality and augmented reality
11. Intelligent geo-synthetics and health systems
12. Sensors and monitoring
13. Asset management
14. Case studies in design, constructions and maintenance

Secretariat Contact

For additional information, please contact the secretariat of the conference:

3rd ICITG Secretariat
University of Minho
Civil Engineering Department
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Website: http://civil.uminho.pt/3rd-ICITG2019

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11th ICOLD European Club Symposium
2 - 4 October 2019, Chania Crete – Greece
www.eurcold2019.com

The Greek Committee on Large Dams (GCOLD) would like to invite you to participate in the **11th ICOLD European Club Symposium** to be held from the **2nd to 4th of October 2019** on the island of **Crete, Greece**. The theme of the Symposium is **"The future of Dams (in Europe): Prospects and Challenges in a changing Environment"**. The Symposium is under the auspices of ICOLD and has the support, among others, of the Greek Ministry of Infrastructure, the Region of Crete and the Organization for the Development of Crete.

The Greek Committee on Large Dams (GCOLD) was formed in 1964 and immediately joined the International Commission on Large Dams (ICOLD). It became a member of the European Club of ICOLD in 2010 and is actively participating ever since.

Dam construction in Greece followed the country's development and large projects were constructed in the last 50 years for hydropower, water supply, irrigation and flood protection. A boom in dam construction occurred in the last 20 years. Many dam types were built to adjust to the complicated geological environment, the availability of construction materials and the high seismicity of the region. Dam design and construction is still strong in Greece.

Recently a National Dam Safety Regulation (DSR) was established together with a Dam Management Authority, responsible for overseeing the application of the DSR.

The Symposium will cover a wide range of topics including Advances in Dam Engineering, Dam Safety and Risk Management, Social impact and awareness, Successes and problems in implementing the European Water Framework Directive and relevant Guidelines and Dam and Reservoir Management in the changing European Environment.

The island of Crete, situated between the Aegean and the Libyan Sea, has been a cross road of ancient civilizations. This has left a rich inheritance of ancient monuments and artifacts of unparalleled beauty. Modern Crete, one of the wealthiest parts of Greece, has built a number of large dams for irrigation, water supply, flood protection and hydro power. Having a substantial infrastructure for conferences and a magnificent natural coastal and mountainous environment, it is an ideal place to combine a successful EuroCOLD Symposium with field trips and recreational activities. Crete in early October is warm enough for enjoying the outdoors and the beaches.

We would like to extend the invitation for participation to the members of EuroCOLD as well as to all ICOLD members. We are expecting you all to come to Crete for a fruitful, memorable and enjoyable 11th ICOLD European Club Symposium.

Symposium Topics

Topic A: Dam Safety and Risk Management. Social impact and awareness

Topic B: Dams and reservoirs in a climate change perspective

Topic C: Successes and problems in implementing the European Water Framework Directive and relevant Guidelines

Topic D: Managing infrastructure

Topic E: Advances in dam engineering

Topic F: The future of Dams in a changing EU Environment

A special lecture will be delivered on all the topics of the Symposium by Experts on the relevant fields.

International Seminar

A two-days Seminar on FLOOD MANAGEMENT, SPILLWAY DESIGN AND PUBLIC SAFETY will be held just before the Symposium, on Monday 30/9/2018 and Tuesday 1/10/2018,

Congress Secretariat:

Professional Congress Organizer
Global Events
E: athens@globalevents.gr
www.globalevents.gr

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Ανακοινώνουμε ότι το 4ο Πανελλήνιο Συνέδριο Αντισεισμικής Μηχανικής και Τεχνικής Σεισμολογίας θα διοργανωθεί από το ΕΤΑΜ στην Αθήνα μεταξύ 4-6 Οκτωβρίου 2019, με την συμπλήρωση 20 χρόνων από τον καταστροφικό σεισμό της 7ης Σεπτεμβρίου του 1999. Περισσότερες πληροφορίες θα ανακοινωθούν σύντομα στο site του ΕΤΑΜ. Η θεματολογία του συνεδρίου περιλαμβάνει:

- Αντισεισμική Ανάλυση και Σχεδιασμός Κατασκευών
- Αντισεισμική Ανάλυση και Σχεδιασμός Γεωτεχνικών Έργων
- Αντισεισμική Προστασία Μνημείων και Ιστορικών Κατασκευών
- Αλληλεπίδραση Εδάφους – Κατασκευής
- Γεωτεχνική Σεισμική Μηχανική
- Τεχνική Σεισμολογία
- Μηχανική / Ανακυκλική Συμπεριφορά Δομικών Υλικών
- Προσομοίωση Συμπεριφοράς Κατασκευών σε Σεισμικές Φορτίσεις
- Κανονισμοί Σχεδιασμού, Αποτίμησης και Ενίσχυσης Κατασκευών
- Σεισμική Απόσβεση και Μόνωση των Κατασκευών
- Εμπειρίες από πρόσφατους σεισμούς στην Ελλάδα και το Εξωτερικό
- Προστασία Μεγάλων Έργων

Ελληνικό Τμήμα Αντισεισμικής Μηχανικής
[illegible] 4, Αθήνα
www.eltam.org
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4ο Πανελλήνιο Συνέδριο
Αντισεισμικής Μηχανικής και
Τεχνικής Σεισμολογίας
20 Χρόνια Μετά...
Αθήνα, 4-6 Οκτωβρίου 2019
www.eltam.org

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XVII African Regional Conference on Soil Mechanics and Geotechnical Engineering
07-10 October 2019, Cape Town, South Africa

The South African Institution of Civil Engineering cordially invites all our colleagues from Africa and beyond to attend the 17th African Regional Conference on Soil Mechanics and Geotechnical Engineering.

Hosted in one of the continent's most iconic cities, this conference will serve practitioners, academics and students of all geotechnical backgrounds. The conference will take place at the Cape Town International Convention Centre (CTICC) offering world class conferencing facilities in the heart of South Africa's mother city and will offer extensive opportunities for Technical Committee Meetings, Workshops, Seminars, Exhibitions and Sponsorships. Exciting Technical Visits, including tours to the famous Robben Island, await.

The 7th African Young Geotechnical Engineers' Conference (8 – 10 October 2019) will commence on 8 October 2019, the day following the African Regional Conference (ARC) opening. The conference venue will be shared with the ARC delegates to initiate dialogue between junior and senior engineers while young geotechnical engineers acquaint themselves with the industry standards, new geotechnical developments and resources available to further their careers. The YGE conference provides an approachable audience within a vibrant environment where young presenters under the age of 35 are encouraged to exercise their presentation and technical writing skills on a continental platform.

Organiser: SAICE
Contact person: Dr Denis Kalumba
Email: denis.kalumba@uct.ac.za

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XVI Asian Regional Conference on Soil Mechanics and Geotechnical Engineering, 21 - 25 October 2019, Taipei, China www.16arc.org

XVI Panamerican Conference on Soil Mechanics and Geotechnical Engineering, 18-22 November 2019, Cancun, Quintana Roo, Mexico, http://panamerican2019mexico.com/panamerican

CS ED

YSRM2019 - the 5th ISRM Young Scholars' Symposium on Rock Mechanics
and
REIF2019 - International Symposium on Rock Engineering for Innovative Future
1-4 December 2019, Okinawa, Japan

Contact Person: Prof. Norikazu Shimizu, jsrm-office@rocknet-japan.org

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14th Baltic Sea Geotechnical Conference 2020
25 ÷ 27 May 2020, Helsinki, Finland

Organiser: Finnish Geotechnical Society
Contact person: Leena Korkiala-Tanttu
Email: leena.korkiala-tanttu@aalto.fi
Website: http://www.ril.fi/en/events/bsgc-2020.html
Email: ville.raassakka@ril.fi

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Nordic Geotechnical Meeting
27-29 May 2020, Helsinki, Finland

Contact person: Prof. Leena Korkiala-Tanttu
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Phone: +358-(0)50 312 4775
Email: leena.korkiala-tanttu@aalto.fi

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EUROCK 2020
Hard Rock Excavation and Support
June 2020, Trondheim, Norway

Contact Person: Henki Ødegaard, henki.oedegaard@multiconsult.no

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Geotechnical Aspects of Underground Construction in Soft Ground
29 June to 01 July 2020, Cambridge, United Kingdom

Organiser: University of Cambridge
Contact person: Dr Mohammed Elshafie
Address: Laing O'Rourke Centre, Department of Engineering, Cambridge University
Phone: +44(0) 1223 332780
Email: me254@cam.ac.uk

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16th International Conference of the International Association for Computer Methods and Advances in Geomechanics – IACMAG
29-06-2020 ÷ 03-07-2020, Torino, Italy

Contact Information

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Email: info@symposium.it, marco.barla@polito.it

CS ED

www.eurogeo7.org

We are pleased to invite you to the 7th EuroGeo conference, to be held in Warsaw, Poland in 2020. Poland is a country with more than a thousand years of recorded history and has a strong European identity. The country was first to free itself from communist domination in 1989 and is now fully democratic and a member of the European Union. Poland is a leader in infrastructure development in the region, which has resulted in many extraordinary projects. Warsaw, with its central location, is an ideal base for exploring the country. Today, the city is a dynamic cultural and business centre, with strong links not only to Western Europe but also to the East. PSG-IGS, a Polish Chapter of IGS is young but thriving organization successfully cooperating with several chapters within Central Europe. It is an honour to host such a prestigious conference in Warsaw and we sincerely believe that the sessions will prove to be a success. Come to Warsaw, bring your family and enjoy your stay in our capital and help us to make this Conference not only scientifically profitable but also an unforgettable event.

Contact: eurogeo7inpoland@gmail.com

6th International Conference on Geotechnical and Geophysical Site Characterization
07-09-2020 ÷ 11-09-2020, Budapest, Hungary
www.isc6-budapest.com

Organizer: Hungarian Geotechnical Society
Contact person: Tamas Huszak
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Email: huszak@mail.bme.hu
Website: http://www.isc6-budapest.com
Email: info@isc6-budapest.com

5TH World Landslide Forum Implementation and Monitoring the USDR-ICL Sendai Partnerships 2015-2015, 2-6 November 2020, Kyoto, Japan, http://wlf5.iplhq.org

Summer Could Trigger Major Earthquakes (It's Not Why You Think)

An earthquake causes the ground to rupture in a vineyard near Buhman Road, Napa Valley, California, on Aug. 24, 2014.

On Aug. 24, 2014, an earthquake ripped through Northern California's Napa-Sonoma Valley. It was the largest in the San Francisco Bay Area in 25 years, leaving two dead and hundreds injured and causing damage that cost half a billion dollars.

When Meredith Kraner, a geophysicist from the University of Nevada, examined seismic recordings from the region around the quake, "we found this really interesting signature in the data," she told Live Science: a telltale pattern of expansion and contraction in the Earth's crust. Now in a study that describes this finding in the Journal of Geophysical Research, Kraner and her colleagues also explore whether seasonal fluctuations in local aquifers might explain that cycle of expansion and contraction, a phenomenon that could have triggered the earthquake itself.

Earthquakes occur when Earth's slow-moving tectonic plates suddenly slip against one another, usually due to a build up of stress that destabilizes the two. "It's just like breaking a stick," Kraner said. "If you pull on it and pull on it, it'll reach breaking point eventually."

But the fluctuations in the Earth's crust that Kraner observed suggested that there may have been an added seasonal element that triggered this process. She identified this pattern by collecting data from Earthscope, a vast network of high-precision GPS sensors spread across the earthquake-prone western United States. Since 2005, these sensors have been recording millimeter-scale shifts in the Earth's crust, building up a huge and detailed data set. Using this information, Kraner was able to precisely map out the expansion and contraction in the crust around the earthquake zone.

"The crust is in extension during the late summer, and it's in contraction during the winter. You see that happening every single year in that location," Kraner said. "Our theory is that this seasonal component provided the final straw to this earthquake occurring," Kraner told Live Science.

But what was behind this unusual seasonal cycle, and how might it be linked to the quake? After the team ruled out several other factors, "the only thing we could think of it being related to was some sort of local aquifer system," Kraner said.

To test that idea, Kraner used satellite data of the Napa-Sonoma Valley, which revealed noticeable seasonal changes in the ground elevation over the areas where aquifer basins exist.

It's known that increases and declines in groundwater levels can cause the elevation at the Earth's surface to rise and fall. Kraner didn't measure the water quantity in these basins, but she surmised that if groundwater levels do recede in summer due to low water availability, that would cause the land above to subside. As this happens, it would pull on the crust, contracting it horizontally and "stretching" or "extending" the land surrounding the aquifer.

By this logic, if aquifer basins on either side of the fault line did recede, this would also cause the land to contract horizontally on either side of the fault. (Indeed, the GPS recordings in Kraner's data showed a 3 millimeter spread across the landscape in summer.) Like loosening a clamp, that would release the stabilizing pressure on the fault, making it easier for plates to slide against each other and trigger an earthquake, Kraner explained: "The earthquake occurred in this expansional/extensional region between these two aquifers."

Does that mean that human-driven depletion of aquifers can set this process in motion and cause earthquakes? Kraner cautioned that the study can't answer this question. Even so, the region is characterized by water-guzzling vineyards that could lead to the contraction of Earth's surface in the area.

"On top of [the aquifers], you do have California wineries. They are pumping a lot of water. We don't know how much," Kraner said. And that dependence on groundwater could increase during the dry summer months and during drought. But Kraner was quick to note that her study didn't measure water volume or pumping rates around the time of the quake.

Groundwater levels also fluctuate naturally, driven by rains, evaporation and other natural phenomena, she said.

But as the first study to identify this localized pattern of expansion and contraction in the Earth's crust, Kraner's research does crucially reveal that seasonal stress may be one of many factors helping to trigger earthquakes. Understanding this seasonal element might one day help scientists create richer and more-accurate forecasts for these phenomena, she said.

"You're adding time dependence to earthquake forecasting," Kraner said. "This is important for understanding how earthquakes are triggered."

(Emma Bryce, Live Science Contributor / LIVESCIENCE, June 22, 2018, https://www.livescience.com/62890-groundwater-levels-major-earthquakes.html?utm_source=ls-newsletter&utm_medium=email&utm_campaign=20180622-ls)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΓΕΩΛΟΓΙΑ

Scientists Now Monitor Volcanic Eruptions through Volcano Music

There might still be hope for the early detection and prevention of volcanic eruptions. Volcano music can help scientists monitor eruptions.

Agencia de Noticias ANDES/Flickr

A group of researchers from Instituto Geofisico revealed that they might be able to monitor volcanic eruptions with the help of the music or infrasound recordings from the Cotopaxi Volcano that is present in Central Ecuador. This new study revealed that Cotopaxi produces very unique sounds that scientists could potentially use in order to monitor the volcano and all its hazards.

Facts state that a volcanic eruption in 2015 caused the volcano's craters to change its shape to a deep cylindrical form. This crater creates sound waves when the forced air reverberates against its walls, causing the volcano to rumble.

The sound resembles that of a pipe organ as pressurized air is forcefully moved through metal pipes.

Jeff Johnson, a Volcanologist at the Boise State University in Idaho who is also the lead author of this study says, "*It's the largest organ pipe you've ever* come across." He adds, "*Understanding how each volcano speaks is vital to understanding what's going on. Once you realize how a volcano sounds, if there are changes to that sound, that leads us to think there are changes going on in the crater, and that causes us to pay attention*."

The new findings reveal that the sounds of the volcano are significantly influenced by the geometry of the volcano's crater. They deduced that a thorough understanding of the "voiceprint" of each volcano could substantially aid scientists in monitoring these natural hazards in a better way.

Furthermore, they can also be lifesavers in alerting scientists to all the changes that are happening inside the volcano in addition to signaling any or all impending eruptions. Johnson is of the opinion that the eruption of Kilauea in Hawaii that is still ongoing could be a potential proving ground to study and understand the impact of the sounds of a crater to the changes in its shape.

Listening to the infrasound of Kilauea could help scientists in monitoring the depth of the Magma from afar in addition to being able to forecast all the potential eruption hazards caused by the volcano.

David Fee, a volcanologist at the University of Alaska Fairbanks, who is not associated with this new study says, "*It's really important for scientists to know how deep crater is, if the magma level is at the same depth and if it's interacting with the water table, which can create a significant hazard*."

It is interesting to note that Cotopaxi was dormant for the majority of the 20th century, although it erupted a number of times in August 2015. These massive eruptions were predicted to melt the immense snowcap of Cotopaxi, which could even trigger massive mudflows and floods, destroying the nearby towns and cities.

This is when the Ecuadorian researchers noticed the strange sounds coming out of the crater and deduced that these dramatic reverberations that were coming from the volcano could potentially be the ticket to avoiding further eruptions and related hazards.

In Johnson's own words, "*It's like opening a bar door that goes back and forth for a minute and a half. It's a beautiful signal and amazing that the natural world is able to produce this type of oscillation*."

(Kashyap Vyas / INTERESTING ENGINEERING, June, 17th 2018, https://interestingengineering.com/scientists-now-monitor-volcanic-eruptions-through-volcano-music?_source=newsletter&_campaign=4ob-gxxqE2D3Qn&_uid=9wdL9JEwej&_h=9480fc0933eb231a0575c535417bef075ed6e805&utm_source=newsletter&utm_medium=mailing&utm_campaign=Newsletter-17-06-2018)

Infrasound Tornillos Produced by Volcán Cotopaxi's Deep Crater

J. B. Johnson, M. C. Ruiz, H. D. Ortiz, L. M. Watson, G. Viracucha, P. Ramon, M. Almeida

Abstract

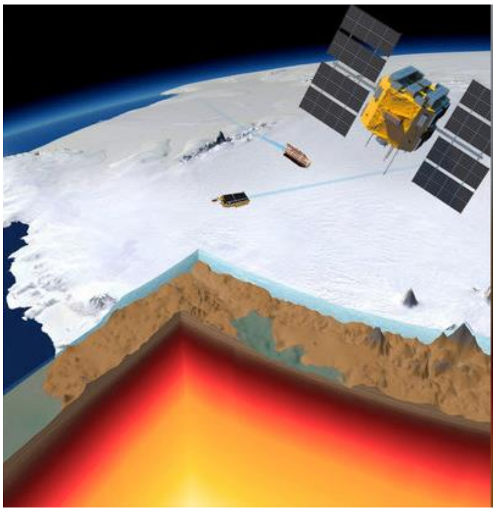
We characterize and interpret a new type of infrasound signal originating from the summit of Volcán Cotopaxi (Ecuador) that was primarily observed between September 2015 and March 2016, following the 2015 eruptive period. This infrasound waveform is a slowly decaying sinusoid with exceptional low-frequency (f_p = 0.2 Hz) and high quality factor (Q = ~10) and resembles the shape of tornillo seismic waveforms. The repeating events, occurring about once per day in early 2016, are stable in frequency content, and we attribute them to excitation of a vertical-walled crater, with radius of about 125 m and length of 300 m. Spectral properties of the tornillo permit constraints on crater sound speed (335 m/s ± 6%) and temperature (4–32°C). The initial polarity of the tornillos is predominantly a rarefaction and could reflect repeating crater bottom collapse events (implosions) or explosion sources whose infrasound is heavily modulated by the crater's pipe-like geometry.

Plain Language Summary

Active volcanoes produce intense infrasound, or low-frequency sounds below 20 Hz, which may be recorded with specialized microphones many kilometers from a volcanic crater. An objective of volcano infrasound research is to infer volcano source processes, such as explosions, and the modulating influences of topographic effects and atmospheric transmission. This study reports on a novel type of signal recorded at Cotopaxi Volcano (in Ecuador) where the infrasound possesses a remarkably low frequency and reverberates for many tens of seconds. We attribute the form of these infrasound events to the geometry of Cotopaxi's crater, which is a deep, steep-walled cylinder about 300-m deep and with a diameter of approximately 125 m and acts like a gigantic pipe resonator.

(Geophysical Research Letters, First published 13 June 2018 https://doi.org/10.1029/2018GL077766, https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2018GL077766)

Antarctica Is Getting Taller, and Here's Why



In an illustration of the Amundsen Sea Embayment in West Antarctica, a cutaway reveals the bedrock below the ice, as well as Earth's crust (brown layer), the bottom of the lithosphere (red area) and the mantle (yellow) underneath.

Bedrock under Antarctica is rising more swiftly than ever recorded — about 1.6 inches (41 millimeters) upward per year. And thinning ice in Antarctica may be responsible.

That's because as ice melts, its weight on the rock below lightens. And over time, when enormous quantities of ice have disappeared, the bedrock rises in response, pushed up by the flow of the viscous mantle below Earth's surface, scientists reported in a new study.

These uplifting findings are both bad news and good news for the frozen continent.

The good news is that the uplift of supporting bedrock could make the remaining ice sheets more stable. The bad news is that in recent years, the rising earth has probably skewed satellite measurements of ice loss, leading researchers to underestimate the rate of vanishing ice by as much as 10 percent, the scientists reported.

An incomplete picture

Interplay between bedrock and mantle in Antarctica is just one of the many geologic processes that happen all over our dynamic planet. Under Earth's crust cover, the molten mantle extends over 1,796 miles (2,890 kilometers) down to Earth's core. Mantle movement is known to ripple up and affect the crust's tectonic plates, as these plates ride convection currents in the mantle's outermost part, known as the lithosphere.

But while computer models give scientists an idea of how the mantle behaves, the picture is incomplete, lead study author Valentina Barletta, a postdoctoral researcher at DTU Space, the National Space Institute at the Technical University of Denmark, told Live Science.

"The study of this — the distribution of viscosity in the mantle — is still in its infancy," Barletta said. "We know where the Earth is hotter and cooler — more or less. However, the viscosity of the mantle depends not just on temperature, but also on water content." Estimating the temperature of the mantle in a given area could therefore give an inaccurate view of how fast-moving it is — a cooler patch with high water content could be just as viscous as a hotter zone that contained less water, Barletta explained.

Dramatic changes such as those that the researchers observed in Antarctica's bedrock — nudged upward by the mantle below — were thought to happen over thousands, or even tens of thousands, of years. Their new findings show that this shift in response to vanishing ice can take place much more rapidly, over centuries or decades. This suggests that the mantle under Antarctica, which is lifting the bedrock upward, may be more fluid, flowing more quickly than previously suspected, the study authors reported.

Measuring rebound

Antarctica's bedrock is difficult to study because most of it is covered by thick layers of ice; the continent's ice sheet cover holds about 90 percent of all the ice on Earth, containing enough water to elevate sea levels worldwide by about 200 feet (61 meters), according to NASA. To measure how it was changing, the researchers installed six GPS stations at locations around the Amundsen Sea Embayment (ASE), a region of the ice sheet roughly the size of Texas, that drains into the Amundsen Sea. They places the GPS monitors in places where bedrock was exposed, gathering data at a spatial resolution of 0.6 miles (1 km), higher than any recorded in prior studies.

A GPS station stands at a site on Backer Islands, a chain of small islands in Cranton Bay, Antarctica.

The scientists expected to see some evidence of slow uplift in the bedrock over time, which could be linked to historic ice loss — because "when ice melts, the earth rebounds elastically," Barletta said. Instead, they saw that the rate of the uplift was about four times faster than anticipated from ice-loss data. The velocity of the rebound in the ASE — 1.6 inches (41 millimeters) per year — was "one of the fastest rates ever recorded in glaciated areas," study co-author Abbas Khan, an associate professor at DTU Space, said in a statement.

Their findings suggested that the mantle underneath is fast-moving and fluid, responding rapidly as the heavy weight of ice is removed to push the bedrock upward very quickly, Barletta said.

An uncertain future for Antarctica's ice

The bedrock uplift is a result of ice loss over the past century, but ice continues to vanish from parts of Antarctica at a dramatic rate, spurred by human-induced climate change. An estimated 3 trillion tons of ice have vanished from the continent since 1992, causing about 0.3 inches (around 8 mm) of sea level rise. And scientists recently predicted that the West Antarctic Ice Sheet (WAIS) could collapse entirely within the next 100 years, leading to sea level rise of up to nearly 10 feet (3 meters).

But the researchers suggest that there may be a ray of hope for the weakening WAIS. The deforming bedrock under Antarctica, buoyed by a fluid mantle, could provide an unexpected source of support for the WAIS, the scientists discovered. In fact, the bedrock's uplift could stabilize the WAIS enough to prevent a complete collapse, even under strong pressures from a warming world.

There's a downside to their findings, too. Estimates of ice loss in Antarctica depend on satellite measurements of gravity in localized areas, which can be affected by significant changes in mass. If the bedrock under Antarctica is rapidly adjusting in response to ice loss, its uplift would register in gravity measurements, compensating for some ice loss and obscuring just how much ice has truly disappeared by about 10 percent, according to the study.

Hopefully, now that scientists are aware of this discrepancy, it can be addressed in future models of disappearing ice, Barletta said.

The findings were published online today (June 21) in the journal Science.

(Mindy Weisberger, Senior Writer / LIVESCIENCE,| June 21, 2018, https://www.livescience.com/62885-earth-rising-under-antarctica.html?utm_source=ls-newsletter&utm_medium=email&utm_campaign=20180622-ls)

Observed rapid bedrock uplift in Amundsen Sea Embayment promotes ice-sheet stability

Valentina R. Barletta, Michael Bevis, Benjamin E. Smith, Terry Wilson, Abel Brown, Andrea Bordoni, Michael Willis, Shfaqat Abbas Khan, Marc Rovira-Navarro, Ian Dalziel, Robert Smalley Jr., Eric Kendrick, Stephanie Konfal, Dana J. Caccamise II, Richard C. Aster, Andy Nyblade, Douglas A. Wiens

Abstract

The marine portion of the West Antarctic Ice Sheet (WAIS) in the Amundsen Sea Embayment (ASE) accounts for one-fourth of the cryospheric contribution to global sea-level rise and is vulnerable to catastrophic collapse. The bedrock response to ice mass loss, glacial isostatic adjustment (GIA), was thought to occur on a time scale of 10,000 years. We used new GPS measurements, which show a rapid (41 millimeters per year) uplift of the ASE, to estimate the viscosity of the mantle underneath. We found a much lower viscosity (4×10^{18} pascal-second) than global average, and this shortens the GIA response time scale to decades up to a century. Our finding requires an upward revision of ice mass loss from gravity data of 10% and increases the potential stability of the WAIS against catastrophic collapse.

(*Science*, 22 Jun 2018: Vol. 360, Issue 6395, pp. 1335-1339, DOI: 10.1126/science.aao1447, http://science.sciencemag.org/content/360/6395/1335)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΛΟΙΠΑ

How Did Easter Island Statues Get Their Massive 'Hats'?

On a restored statue platform on the south coast of Rapa Nui, a statue wears a red stone "hat" atop its head.

Archaeologists put on their thinking caps to solve a long-standing puzzle about another kind of cap: the enormous stone "hats" that sit atop the heads of colossal statues on Easter Island, a place also known as Rapa Nui.

The solemn, carved faces of the imposing rocky figures, or moai, are a dramatic sight, towering up to 33 feet (10 meters) high and weighing as much as 82 tons (74 metric tons). Many of the statues are topped by red stone cylinders called pukao, carved separately from the statues and made of a different type of rock.

And researchers finally have answers about how those hefty toppers were transported and lifted into place, reporting the findings May 31 in the Journal of Archaeological Science.

Rapa Nui, located in the Pacific Ocean about 2,300 miles (3,700 kilometers) east of Chile, was first populated by people around 800 years ago. Over time, these people crafted about 1,000 giant statues, which they may have moved into position by "walking" them upright along roads, rocking them from side to side with ropes to travel long distances across the volcanic island.

Prior studies suggested that pukoa represented a type of hairstyle worn by the Rapa Nui people. But it was unclear if pukao were placed on top of the statues before the moai were moved into place or afterward, and experts were also uncertain about exactly how the large headpieces were maneuvered onto the giant heads, the researchers wrote.

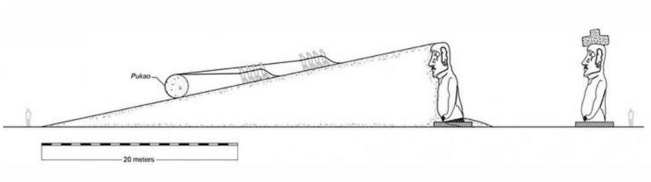
Rock and roll

In the new study, the scientists photographed and digitally modeled 50 pukao — some on statues and some abandoned on the ground — and 13 unfinished cylinders from the pukao quarry on Rapa Nui. They then looked for structural similarities that might offer clues about how the giant stones were prepared, moved and installed.

Sizable pukao weighed as much as 13 tons (12 metric tons) and measured as big as 6.5 feet (2 m) in diameter, the researchers reported. Pukao found scattered around the island were bigger than the ones perched on statues; this told the scientists that the cylinders were likely rolled unfinished to sites where statues already stood. Chips of the distinctive red stone found near statue-mounted pukao hinted that they were carved into their final shapes on those sites, the scientists wrote in the study.

A red pukao was restored atop a moai located on the south coast of Rapa Nui.

To install pukao, workers used dirt to build ramps at the front of forward-leaning statues. People at the top of a ramp would have hoisted the hat up to a statue's head using a process called parbuckling, often used to right capsized ships, the study suggested. First, the workers would have attached a single long rope to the steepest part of the incline, wrapped the ends around the stone and pulled the ends to drag the cylinder up. Even the biggest pukao could have been moved this way by 15 or fewer workers; the technique would have stabilized the stone and kept it from rolling back down, according to the study.



A diagram demonstrates how a pukao may have been positioned on top of an Easter Island statue (Scale 20m).

Previous research noted that construction of the statues on Rapa Nui led to widespread deforestation, with trees sacrificed as building materials or to clear land for roads or agriculture to feed the imagined thousands of workers that must have been required for the statues' construction, the study authors reported.

However, the new findings about the ingenuity and efficiency of the Rapa Nui people paint a different picture. This research suggests that the enigmatic builders maintained a more sustainable relationship with their island ecosystem "and used their resources wisely to maximize their achievements and provide long-term stability," study co-author Carl Lipo, a professor of anthropology at Binghamton University, said in a statement.

"These were quite sophisticated people who were well-tuned to the requirements of living on this island," Lipo said.

(Mindy Weisberger / Senior Writer LIVESCIENCE, June 5, 2018, https://www.livescience.com/62747-easter-island-statues-hats.html?utm_source=ls-newsletter&utm_medium=email&utm_campaign=20180606-ls)

The colossal hats (*pukao*) of monumental statues on Rapa Nui (Easter Island, Chile): Analyses of *pukao* variability, transport, and emplacement

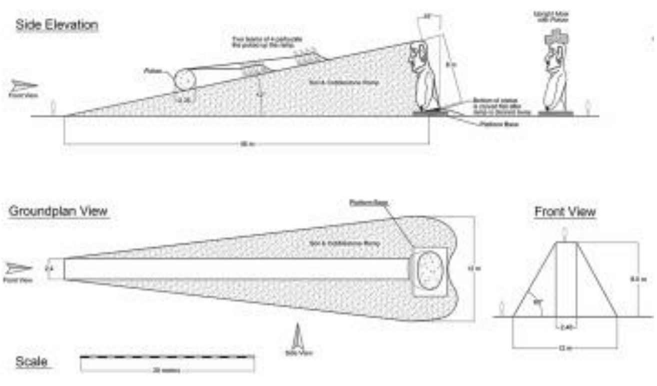
Sean W. Hixon, Carl P. Lipo, Ben McMorran, Terry L. Hunt

Highlights

- Photogrammetric analyses provide 3D models of hat features (*pukao*) from Easter Island, Chile.
- Analyses of 3D models of *pukao* provide evidence for manufacture and transportation.
- The *pukao* were likely moved with minimal labor and using a parbuckle technique.
- Evidence for *pukao* transport is inconsistent with population collapse following “ecological suicide”.

Abstract

The archaeological record of Rapa Nui (Easter Island, Chile) is noteworthy for its massive statues (*moai*) that were transported over long distances with relatively small numbers of people and minimal use of resources. Equally impressive are the colossal bodies of red scoria (*pukao*) placed on the heads of many of the *moai.* In this study, we use three-dimensional models of 50 *pukao* found across the island and 13 red scoria cylinders from Puna Pau, the island's *pukao* quarry, to study the process of *pukao* manufacture, transport, and placement atop statues. Our analysis identifies surface features that are explained by the process of construction and transport of these multi-ton objects. Based on shared physical features of *pukao*, evidence in the archaeological record, and the physics necessary for *pukao* movement, we propose a falsifiable hypothesis in which relatively small numbers of people rolled *pukao* up stone ramps to place *pukao* atop *moai*. We conclude that activities of *pukao* production and transport did not require oversight by a centralized political authority, nor do they support notions of a large population that collapsed with “ecological suicide” on Rapa Nui.



Journal of Archaeological Science (Available online 31 May 2018), https://doi.org/10.1016/j.jas.2018.04.011

Why is the Hexagon Everywhere? All about this Seemingly Common Shape

Fascinating facts about the most interesting geometrical shape that we find almost everywhere around us.

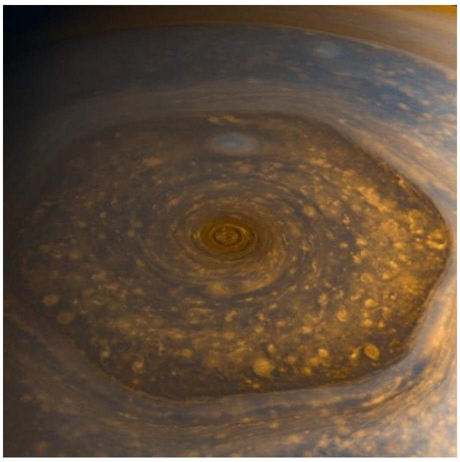
In easy words, a hexagon is a simple shape with six sides. But this seemingly simple shape is nothing less than a wonder. You might even be surprised to know that hexagonal shape is present throughout your life and nature in more places than one.

Let’s take the beehive as an example where each cell is a hexagon. Take things a bit more microscopic and the most important piece of the organic material, Carbon, has a molecular structure that of a hexagon with carbon atoms at each corner.

“The force that makes the winter grow its feathered **hexagons** of snow, and drives the bee to match at home. Their calculated honeycomb is abacus and rose combined. An icy sweetness fills my mind, a sense that under thing and wing lies, taut yet living, coiled, the spring.” - Jacob Bronowski

Let us see why hexagon has so many stories, mysteries, and accolades attached to it.

Saturn’s own hexagon



Source: *NASA/JPL-Caltech/SSI/Kevin M. Gill*

Let us start with something out of this world, literally! If one were to see the North Pole of Saturn from space, they could see a cloud formation over the planet.

However, this isn't any ordinary cloud, and you can see why when you pay attention to the shape of the cloud. Yes, it is a hexagon.

Why does a cloud resemble the shape of a hexagon? Even scientists today can't answer that question, although there are some theories about it, none have been verified.

Want to know another piece of interesting information? Each side of Saturn's Hexagon measures more than earth's diameter!

Water Spinning At High Velocity

This is an extension of the Saturn's hexagon. When you rotate water in a container at very high speed, the inner hole takes the shape of a hexagon. This might be the key to unlocking why the Saturn pole clouds take the shape of a hexagon.

In one of the experiments, the Researchers at the Technical University of Denmark in Lyngby created several shapes by spinning the water at different speeds. They poured water into the bucket and set the bucket to spin.

The shapes started to appear at about seven revolutions per second. In lower speeds, the first shape that appeared was a triangle. Then as the speed increased, the shapes also changed.

With increased speeds, the triangle changed into a square and then to a pentagon. But at the highest possible speeds, the resultant shape was of a hexagon.

Even though, the researchers were unable to give a clear explanation on why the hexagon is formed when water spins at high speeds!

The Tiny Engineers – Bees!

Source: Don Hankins/Flickr

This is one of the most obvious and easiest to spot in nature. Whenever you see the insides of a beehive, the number of packed hexagons are truly a marvel.

For centuries, scientists were confused on why bees chose the shape hexagon as opposed to shapes like square or circle. The answer comes in the form of packing efficiency.

It was found that if a series of circles were packed on top of each other, there were empty spaces in between them. The only way in which these empty spaces can be avoided is by changing the shape to a hexagon.

The Dragonfly Eyes

If you look closely at a dragonfly, its eyes are a collection of tiny eyes often known as compound eyes, each of which functions as an individual visual receptor. Each eye forms a shape of the hexagon.

Source: Mcamcamca/Flickr

To make up the complete set, over 30,000 hexagonal eyes are packed together. The result is a vision that scientists call ultra-multicolor. It is the world's most advanced type of vision and is better than anything we have seen so far in the animal kingdom.

To put it into comparison, the human vision encompasses tricolor vision. This is because we have three types of light-sensitive protein in our eyes. These proteins are called opsins.

In the case of a dragonfly, it has 30 different kinds of opsins in its eyes. Therefore, the color differentiation abilities of a dragonfly are far more superior to ours in every possible way.

Again, the possibility for a dragonfly to have over 30,000 compound eyes is because of the high packing efficiency of the hexagonal shape.

The Giant's Causeway

Source: Chmee2/Wikimedia Commons

You might be wondering by this tourist spot in Ireland which has such a bizarre name. The answer lies in the legend that surrounds this place.

According to a popular myth, a giant called Fionn Mac Cumhaill built these columns. He built it as a causeway to fight a Scottish giant called Benandonner.

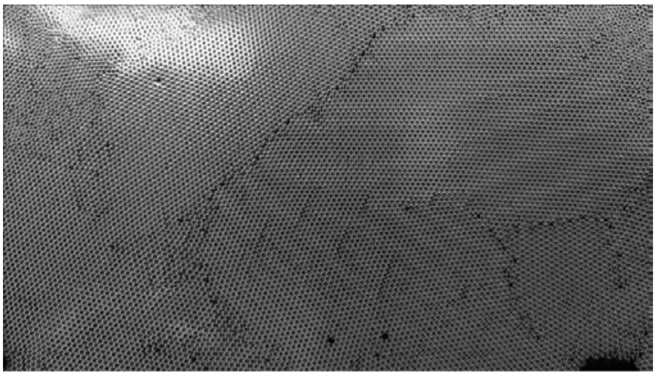
This causeway connected both the locations and be the fighting area for the two. There are two versions to this story. In the first one, the Fionn defeated the Scottish giant, and in the other, he flies from the Scottish giant, destroying the path he had made.

But science has a different story to tell. The rock formation is a result of the rapid cooling of lava, specifically the Columnar Basalt. When molten lava cools, it contracts. This contraction leads to crack formation, and the hexagonal structure is the result of crack formation under maximum energy release.

This was explained after the study led by the physicist Stephen Morris and his college Lucas Goehring from the University of Toronto found success.

"The columns are formed as a sharp front of cooling moves into the lass flow, assisted by the boiling of groundwater," Goehring explained at the time. "As the front advances, it leaves behind a crack network which evolves into an almost hexagonal arrangement. This network carves out the columns."

Bubble Raft



https://www.youtube.com/watch?v=-qcys9XuNe8

A bubble raft is nothing but an array of bubbles packed close together. It is regularly seen on the water surface with tiny soapy form covering it. But have you ever gave it a second glance?

If you do, you will notice that each bubble would be having the shape of a hexagon, provided there will be some irregularities. The reason for this phenomenon again goes back to the efficient packing structure.

When accommodating these many bubbles, the surface tension of each bubble will try to co-exist with the adherent bubble by spending the least amount of energy. This leads to filling up the gaps, and the result is an array of hexagonal structures.

It is truly amazing how hexagons in nature exist before our eyes, and even then, we often miss them!

The Majestic Snowflakes

Source: *Pixabay*

Another example of finding hexagons in nature is the humble snowflake. They are mesmerizing and quite mysterious on how they get the hexagonal shape.

To define a snowflake in the simplest form, they are tiny droplets of water that are frozen in midair. Snowflakes come in different shapes and sizes, but the most predominant shape is the hexagon.

The reason for the shape is the orientation of water molecules themselves. Water is composed of two hydrogens and one oxygen molecule.

Water molecules change orientation with temperature. This is the reason why they can exist in three forms as water, ice, and steam. This is the same case for almost all of the materials found on earth.

When water undergoes a phase change to ice, two water molecules come together to form a hexagon. Since there are an enormous amount of atoms, the continuous chains of molecules, make up a large hexagon.

The example of snowflake carries the message of the hexagon in nature twofold. The overall shape of the snowflake is a hexagon, and the internal structure of the water molecules resembles the same.

The symmetry of the structure is also owed to the hexagonal structure of the molecules within itself. The whole design structure is carried over the entire snowflake structure.

Hexagon On A Turtle Shell!

Source: Tokugawapants/Wikimedia Commons

Nature has numerous beautiful species that reflect magnificent designs, and one of the species are tortoises. Their shells are what protect them, and on them, we can also find hexagons.

These slow-moving animals are protected with a hard shell that is made of one of the toughest compounds found in nature. But have you ever observed the pattern on the shell?

If you look closely, you can see that the entire shell is formed from individual subunits. A closer look further reveals that these cells have a shape resembling a hexagon.

The subunits are given hexagonal shape because they are one of the most efficient geometrical shapes that can cover curved surfaces with minimal material wastage. After the inner hexagonal layers are formed, the shell is completed with filler shapes that constitute differently sized polygons.

Everything Begins with Carbon

You may fail to notice hexagon in yourself, but you need to remember that there are several billions of them in our body than you can ever imagine. It all comes down to the element that is present throughout our body - Carbon.

This element is even present in our DNA and makes up the human body from head to toe.

"Chemistry dissolves the goddess in the alembic, Venus, the white queen, the universal matrix, Down to the molecular hexagons and carbon-chains." - Kathleen Jessie Raine

If you were to study the atomic structure of organic material like the human skin or flesh, you would find a series of carbon hexagon chains that are nicely packed together.

The Hexagonal Shape of Nuts and Bolts

Source: Tomascastelazo/Wikimedia Commons

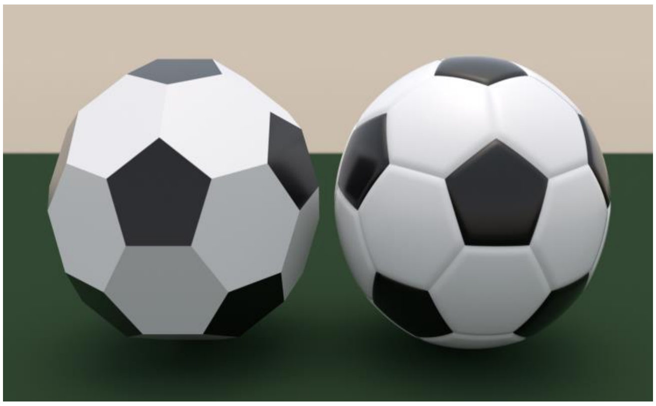
When you think of hexagons all around us, the most relatable objects that use a hexagonal shape are nuts and bolt heads. Hexagon is the predominantly used shape for nuts and bolts because of its unique features.

With hexagons, the tool edges find it much easier to grip the bolt. This means that more torque can be transferred to the bolt. This is why this design still reigns as the undisputed champ even though the design dates back to the 1700s.

The reason why hexagon is able to grip the tools is because of the degree of roundness it has. To be more precise, the hexagon is the only shape that stands between a polygon and a circle.

If you add more sides to a hexagon, it will closely resemble a circle. If you take away sides from a hexagon, it will become unusable.

Ever noticed a Football?!



Source: Aaron Rotenberg/Wikimedia Commons

Football isn't just an ordinary ball. Technically, you will not find a circular shape on football.

The modern-day football is a mix of hexagons and pentagons. It is made from patches of 20 hexagons and 12 pentagons.

But this begs the question of why other shapes aren't used? The reason is pretty simple as hexagon is the only shape that resembles a circle that also allows for close packing without leaving out any waste space.

The pentagons are used to fill in the spaces that will eventually bind things up to give a near perfect spherical structure.

Your Everyday Pencils

Source: Tomomarusan/Wikimedia Commons

Even the most common things we use has a hexagonal relationship. The pencils that we use are hexagonally shaped.

There are many theories on why hexagon shape is given to the majority of pencils found today. Many believe that it is done to prevent the pencils from rolling off the edges.

Others theorize that the shape gives maximum holding comfort. There are even theories that pencils are made into hexagonal cylinders to enable better packing when these are packaged in boxes.

With a hexagonal shape, the manufactures could pack in more pencil per volume than any other shape, and they become easy to store!

The Amazing Power of Hexagon!

It's truly fascinating how hexagons are part of our everyday lives, but we fail to realize its power most of the time. The 6-sided polygon has more to it than we have ever thought, and some of the aspects of this shape are still mysterious.

Paying more attention to the details present all around us, however, could help us uncover more information about this interesting shape.

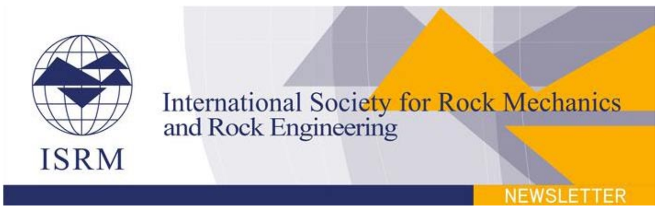
(Kashyap Vyas / INTERESTING ENGINEERING, June 10th, 2018, https://interestingengineering.com/why-is-the-hexagon-everywhere-all-about-this-seemingly-common-shape)

ΗΛΕΚΤΡΟΝΙΚΑ ΠΕΡΙΟΔΙΚΑ

www.issmge.org/publications/issmge-bulletin/vol12-issue-3-june-2018

Κυκλοφόρησε το Τεύχος 3 του Τόμου 12 του ISSMGE Bulletin με τα παρακάτω περιεχόμενα:

- Message from the ISSMGE President
- Report from CAPG
- Research highlights – Pontificia Universidad Católica de Chile and the Universidad de Chile
- Major project – Hong Kong Theme-based project on landslide mitigation
- News from the Canadian Geotechnical Society
- Conference reports
    - ISSMGE International Seminar, Belarus
    - Days of Geotechnics, Russia
- Young members' arena
- ISSMGE Bright Spark Lecture
- Hot news
- Obituary
    - Prof. Tom Schanz
    - Prof. Tien H. Wu
- ISSMGE Foundation reports
- Event Diary
- Corporate Associates
- Foundation Donors



https://www.isrm.net/adm/newsletter/ver_html.php?id_newsletter=152

Κυκλοφόρησε το Τεύχος No. 42 (Ιουνίου 2018) του Newsletter της International Society for Rock Mechanics and Rock Engineering με τα παρακάτω περιεχόμενα:

- Message from the President
- ARMS10, the 2018 ISRM International Symposium, 29 Oct - 3 Nov, Singapore
- 22nd ISRM Online Lecture by Prof. Håkan Stille
- Prof. Xia-Ting Feng elected President of FedIGS
- 14th ISRM CONGRESS - submission of abstracts
- New videos of ISRM Suggested Methods
- Brazilian Symposium on Rock Mechanics – SBMR 2018
- AUSROCK 2018, 28-30 November, Sydney, Australia - an ISRM Specialized Conference
- The 2019 Rock Dynamics Summit in Okinawa - an ISRM Specialized Conference
- Report on Eurock 2018 in St. Petersburg, Russia
- Report on TuniRock 2018
- ISRM Rocha Medal 2020 - nominations to be received by 31 December 2018
- Visit to Slovenia and Croatia National Groups
- ISRM Sponsored meetings
- 3rd ICITG, Guimaães, Portugal, 29 Sep. to 2 Oct. 2019 - Call for abstracts

https://www.sciencedirect.com/journal/geotextiles-and-geomembranes/vol/46/issue/3

Κυκλοφόρησε το Τεύχος 3 του Τόμου 46 του περιοδικού Geotextiles and Geomembranes με τα παρακάτω περιεχόμενα:

Original Research Articles

Centrifuge model tests on the use of geosynthetic layer as an internal drain in levees, R.K. Saran, B.V.S. Viswanadham, Pages 257-276

Numerical analysis of geocell-reinforced retaining wall failure modes, Fei Song, Huabei Liu, Liqiu Ma, Hongbing Hu, Pages 284-296

Full-scale mechanically stabilized earth (MSE) walls under strip footing load, Hamzeh Ahmadi, Adam Bezuijen, Pages 297-311

Optimal placement of reinforcement in piggyback landfill liners, D.H. Marx, S.W. Jacobsz, Pages 327-337

Shear strength of interfaces between unsaturated soils and composite geotextile with polyester yarn reinforcement, Apiniti Jotisankasa, Natthapat Rurgchaisri, Pages 338-353

Numerical simulation of compaction-induced stress for the analysis of RS walls under working conditions, S.H. Mirmoradi, M. Ehrlich, Pages 354-365

Technical Notes

Effect of shearing rate on the behavior of geogrid-reinforced railroad ballast under direct shear conditions, Kumari Sweta, Syed Khaja Karimullah Hussaini, Pages 251-256

Uniaxial compression behavior of geotextile encased stone columns, Jian-Feng Chen, Xing-Tao Wang, Jian-Feng Xue, Yue Zeng, Shou-Zhong Feng, Pages 277-283

Bearing capacity of horizontally layered geosynthetic reinforced stone columns, Mahmoud Ghazavi, Ahad Ehsani Yamchi, Javad Nazari Afshar, Pages 312-318

Load-settlement characteristics of large-scale square footing on sand reinforced with opening geocell reinforcement, A. Shadmand, M. Ghazavi, N. Ganjian, Pages 319-326

ΕΚΤΕΛΕΣΤΙΚΗ ΕΠΙΤΡΟΠΗ ΕΕΕΕΓΜ (2015 – 2018)

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